

**DO WE NEED SEPARATE SPACE THEORY:
THE LESSONS OF HISTORY**

by

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Maj Marheine is married to the former Rebecca Mates and has three children: Andrew, Madeline, and Rachel.

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Abstract

How we think has important effects on what possibilities our thoughts produce. The impact of theory on how we think can not be overstated. Acknowledged or not, humans process information through mental constructs to make order out of chaos and that fundamentally affect the relative importance ascribed to the incoming data. Professionals throughout the Department of Defense and other branches of the US government have long debated the need to produce separate space theory or whether a modified version of air theory is sufficient to guide the emerging ability to exploit space. Too often, this debate devolves into frequently acrimonious arguments over resource allocation and service independence rather than the addressing the fundamental issue of theory. This study ignores these issues in the attempt to resolve the fundamental question: are the physical characteristics of the space environment sufficiently different to require an independent body of theory to guide operators in seizing its full exploitation potential?

Space is not the first environment that man has gained a new ability to exploit as a result of improving technology. The ability to exploit the subsurface naval environment began emerging in the early 1900's and was significant in both World Wars. The study uses a six-question methodology to examine how Imperial Japan and the US developed their ability to exploit the subsurface medium as evidenced in WW II. The study's emphasis is on understanding how the naval services arrived at the decision whether to develop independent subsurface theory or integrate subsurface exploitation into existing surface naval theory. The study then applies the same methodology and the lessons of the naval cases to the air and space decision we currently face.

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Chapter 1

Introduction

The primary purpose of any theory is to clarify concepts and ideas that have become, as it were, confused and entangled. Not until terms and concepts have been defined can one hope to make any progress in examining the question clearly and simply and expect the reader to share one's views.

—Carl von Clausewitz

Professionals in the United States Air Force (USAF) have long debated the need to develop separate space theory versus modifying existing air theory to guide the exploitation of the space medium. The heart of this argument is a fundamental disagreement over whether the differences in the air and space environments are relevant to warfighting theory. Aerospace enthusiasts emphasize the similarities between air and space, asserting the differences between them are irrelevant in terms of theory. Space enthusiasts focus on the differences between the environments and maintain that the similarities are superficial. Rather than address this fundamental disagreement, however, the debate too frequently leaps to the organizational and resource allocation issues that may or may not follow from either of the basic positions. But have we followed Clausewitz's advice? Have we defined the essential terms and concepts well enough to speak and write in ways that will enable us to resolve the fundamental disagreement between aerospace and space advocates? This author responds in the negative, the assertion of which forms the basis of the study.

Background and Importance

Robert O'Connell, in his book *Of Arms and Men*, argues that war is a cultural creation of the human species initiated to gain influence over other humans, a behavior unique to the human animal. He attributes the willingness to gain influence by force to man's desire for economic and political control: power and wealth.¹ Much as the US as a nation, or we as individuals, might wish it different, this fundamental source of conflict is unlikely to disappear any time soon. Faced with the likelihood of future conflict, developing the means to fight and win the nation's wars is of paramount importance. "Developing means" requires making tradeoffs in costs and benefits because resources will always be limited. Making "cost-benefit tradeoffs" requires the ability to debate and select the course of action deemed most appropriate, providing the structure to conduct the debate is the province of theory. Though there are as many definitions of theory as there are people, a very usable definition was provided by J.C. Wylie: a theory organizes experiences and ideas to identify those, which might have, transfer value to a new and different situation.²

For military professionals, doctrine takes theory from the realm of thought into the realm of action. Dennis M. Drew has constructed an extremely useful analogy to help gain an understanding for the role of military doctrine in military affairs. Sharing credit with Dr. I. B. Holley, Drew defines military doctrine as "what is officially believed and

¹ Robert O'Connell, *Of Arms and Men* (New York: Oxford University Press, 1989), 30.

² J.C. Wylie, *Military Strategy: A General Theory of Power Control*, (1967; reprint, Annapolis, Md.: Naval Institute Press, 1989), 31.

taught about the best way to conduct military affairs.”³ Drew’s discussion of the importance of this definition is instructive:

First, using the word “best” connotes military doctrine’s importance to the successful conduct of military operations. Second, the term “military affairs” implies that doctrinal concepts are not limited to battlefield engagements with an enemy. A broader concept of military doctrine is particularly important during an era in which the development and deployment of forces rivals the importance of the employment of those forces. Third, the word “taught” suggests an important function of military doctrine, which will be discussed later. Finally, the word “believed” directly suggests the interpretive and thus transmutable nature of military doctrine.⁴

Using a tree to represent the totality of doctrine and their interrelationships, Drew suggests the roots of a doctrine tree are history and experience, the trunk is fundamental doctrine based on a general theory of war, the main branches represent environmental doctrine based on medium-specific theory, and finally the leaves represent organizational doctrine designed to guide the efforts of military organizations in a specific medium.⁵

Understanding the role of theory and doctrine in military affairs illuminates the importance of the question this study endeavors to answer. Whatever the ultimate response, the repercussions for development of military theory and doctrine to guide the exploitation of the space medium are significant. As Drew suggests in his tree analogy, the fruits of victory achieved by organizational doctrine are dependent on the supporting structure; if the roots, trunk, or branches are “diseased” or inadequate, the leaves will wither and die (lead to defeat).⁶ In short, how we choose to think about exploitation of

³ Dennis M. Drew, “Of Trees and Leaves: A New View of Doctrine,” *Air University Review* 33, no. 2 (January – February 1982): 42 and endnote 4.

⁴ Drew, 42.

⁵ Drew, 45.

⁶ Drew, 45.

space, whether as part of an indivisible aerospace medium or as a separate space medium, matters.

Italian Air Marshal Giulio Douhet is generally credited with developing the first theory of airpower in his book, *The Command of the Air*, originally published in 1921.⁷ Filled with prescriptions for conducting what today would be classified as crimes against humanity, Douhet's theory emphasized exploiting the key offensive characteristics offered by operating in the air: freedom of maneuver and speed.⁸ From Sun Tzu to Clausewitz and Jomini, Mahan and Corbett to Douhet and Mitchell, efforts to exploit the physical attributes of a medium are common to all the theorists regardless of the medium about which they wrote. In contrast to other media, no one has managed to develop a space theory that operators have embraced. Several individuals have tried to formulate basic theory, but in each case they have caveated their effort with the disclaimer that thinking about space is in its infancy.⁹ The reasons why this is so are varied and necessarily speculative but the effect is clear: strategists have little to guide them in the attempt to realize the potential of space. The USAF decision to treat air and space as a seamless operational medium is the first step down a path intended to resolve this problem. The effect of this decision is to rely on the supporting "branch" of airpower theory to grow the "leaves" of aerospace organizational doctrine. This study seeks to determine if it is the right path.

⁷ Phillip S. Meilinger in the "Introduction" to *The Paths of Heaven: The Evolution of Airpower Theory*, ed. Colonel Phillip S. Meilinger (Maxwell AFB, Ala.: Air University Press, 1997), xiii. Also see Giulio Douhet, *The Command of the Air* trans. Dino Ferrari (1942; new imprint, Washington, D.C.: Air Force History and Museum Program, 1998).

⁸ Douhet, 15.

⁹ See for example Michael R. Mantz, *The New Sword: A Theory of Space Combat Power* (Maxwell AFB, Ala.: Air University Press, 1995); Jim Oberg, *Space Power Theory*, (Colorado Springs, Colo.: USAF Academy Press, 1999); David E. Lupton, *On Space Warfare: A Space Power Doctrine*, (Maxwell AFB, Ala.: Air University Press, 1988).

The Question and Its Assumptions

This study attempts to resolve the fundamental disagreement between aerospace and space enthusiasts by answering the following question: Are the characteristics of operating in orbital space sufficiently different from those of operating in the atmosphere to suggest the need for a separate body of theory to exploit fully the potential capabilities of space power? Implicit in this question is the premise that discussions of organization or resource allocation are premature pending resolution of the fundamental disagreement; the study therefore leaves these questions unasked and unanswered.

Recognition of the assumptions included in this question is important if we are to follow Clausewitz's advice to define terms and concepts plainly. The first assumption is that air and space are two distinct media, an assumption that, until recently, would itself result in a good deal of debate. However, with the publication of *The Aerospace Force*, the USAF's long-range strategic plan, USAF leaders acknowledged the physical differences in the media. "Our Service views the flight domain of air and space as a seamless operational medium. The environmental differences between air and space do not separate employment of aerospace power within them."¹⁰ Logically, acknowledging environmental differences exist is clearly a recognition of differences in the physical characteristics of the media, and hence, acknowledgement that two distinct media exist. Because this assertion is still somewhat contentious, however, the study devotes additional attention to it in Chapter 5.

¹⁰ United States Air Force, *The Aerospace Force* (Washington D.C., 2000), i. See also, United States Air Force, *America's Air Force Vision 2020: Global Vigilance, Reach, and Power*, (Washington D.C., 2000), 3.

The second important assumption is that there is a way to determine whether environmental characteristics are *sufficiently* different to warrant development of unique space theory. To help determine sufficiency, this study examines two historical cases from World War II that highlight differences in the way the US Navy and the Imperial Japanese Navy employed submarines. These cases were chosen because they provide examples in which decision-makers were forced to determine how, in terms of either integrated or unique theory, to best exploit the emerging potential of a new medium to achieve military objectives. The cases offer an additional opportunity to compare results obtained from opposite approaches. The subsurface warfare theory question is similar to the one we face in the “air and space” or “aerospace” debate, and that is why case studies involving submarines are pertinent to debates about air and space power.

Naval surface warfare and airpower theory exists; space power theory and naval subsurface theory during the period investigated herein do not exist. In the absence of clearly defined theory, military services develop doctrine based on an inductive understanding of history and experience. Complicating the analysis contemplated here is the fact that theory and doctrine are not synonymous, however studying military doctrine provides insight into how planners thought about the media they exploited. Accepting Drew’s definition of doctrine as what planners believe is the “best” way to conduct military affairs, doctrine may in fact provide even greater insight into what planners believed than the underlying theory. Our aim is to understand how planners’ thinking affected exploitation of a given media, therefore the study substitutes doctrine to fill in theoretical gaps when appropriate. The blurring of theory and doctrine is regrettable but, in this study, unavoidable.

It is worth a brief pause to explain why the most obvious case was not selected for this study. The separation of American air and ground power following WW II certainly meets the fundamental requirements for the question under consideration. However, it is also the favorite analogy of both “aerospace” and “air and space” partisans. This analogy has become overdetermined in the current debate, simultaneously supporting both positions, with implications about service independence serving to inflame emotions on both sides. This case simply has too much “baggage,” especially when other cases better illuminate the ramifications of the decision we face.

Methodology

This study will consist of a focused comparison of three cases: two historical and the current air and space debate. In each case, we will examine a military service expanding operations into a new medium. The emphasis will be on determining whether the differences between the media were relevant to existing warfighting theory, and if so, what actions the service took to resolve these differences in terms of its theory. The analysis will answer the following six questions within each case:

Question #1: What are the physical attributes of each operating medium?

Answering this question requires examination of each medium in isolation to identify the physical attributes that govern operations in that medium. The purpose of this analysis is simple: to get the facts out in front of everyone to consider as we move forward in the analysis. An obvious assumption integral to this question is the idea that each medium has distinguishable physical attributes. Support for this assumption will be

evident as each medium is analyzed and we answer the question, “What makes this medium different from other media?”

Question #2: How did these attributes shape existing warfighting theory?

Operating in a new medium is all well and good, but what do these new operations mean to warfighting theory? To answer this question requires we first understand how the attributes of the medium shaped existing warfighting theory. In other words, what attributes of the medium did existing warfighting theory exploit?

Question #3: Were differences in the attributes of the second medium relevant to existing theory?

For an attribute to have any importance in this study, it must effect warfighting theory in some way. The fact that water boils at 100 degrees Celsius (at sea level) is a physical attribute of water, but is irrelevant to warfighting theory. Conversely, the fact that terrain features dictate the activity of ground forces is extremely relevant to warfighting theory. The emphasis in answering this question is to identify those attributes of the new medium that directly affect the ideas or experiences supporting the existing theory.

Question #4: Could existing theory accommodate relevant differences between media; if not, was new theory developed to enable warfighters to exploit fully the new medium?

Judging whether an existing theory can accommodate the relevant differences present in a new medium is somewhat subjective; however, we must reach a determination if we are to learn from this study. To address subjectivity, the study will emphasize the identification of actual and potential effects, seeking to determine whether these effects are achievable within existent theory.

Question #5: What impact did contextual influences have on the decision to develop separate or to adapt existing theory?

This question specifically acknowledges that warfighting theory does not exist in a vacuum, but rather is highly dependent on a vast number of contextual factors present in and around the decision-making process. Examining the contextual influences of a decision improves our understanding of how a decision came to be while offering insight into what factors might influence future decisions in similar circumstances.

Question #6: What operational impacts occurred as a result of how the service resolved the theory question?

The final question in the case analysis examines results obtained or possible because of the decision made on whether to develop new theory. The answer to this question from the two historical cases, will be applied to the air and space case in the attempt to gain predictive insight.

Structure

This thesis is organized in six chapters. Initially, the study examines the emerging potential to exploit the subsurface medium. As the first three questions of the methodology deal specifically with the media and theory in isolation, the answers to these questions comprise Chapter 2. To ease the mental workload in maintaining the coherency of the individual cases, the remaining analysis for the subsurface media is split into two chapters, one each for the US and Japanese cases. Chapters 3 and 4, then, examine the answers to questions four through six for the US and Japanese navies, respectively. Chapter 5 documents the study of the air and space case. Finally, Chapter 6 draws the lessons from each case to the fore in making conclusions about, and recognizing implications of, the analysis.

Chapter 2

The Naval Media

Preparedness for naval war – preparedness against naval attack and for naval offense – is preparedness for anything that is likely to occur.

—A. T. Mahan

Though less well known to airmen, the evolution of the submarine during the inter-war years was every bit as chaotic as was that of the airplane, plagued by many of the same technological, institutional, and employment disagreements. The purpose of this chapter is to understand how the emerging potential to exploit the subsurface medium affected warfighting theory. Of particular interest to this study is the decision to either integrate the emerging subsurface medium into existing naval (surface) theory or to develop independent subsurface theory to exploit the new medium. To begin the analysis, we ask and answer the first three questions of the methodology for the naval surface and subsurface media.

Attributes of the Sea Media

From the earliest of times through the foreseeable future, water-borne transportation is the most efficient means to transfer goods from one place to another. It is the medium of choice for inter- as well as intra-state commerce. Recalling O’Connell’s sources of human conflict illuminates why the wealth transported by a nation’s merchant shipping has long been a target of nations in conflict. Naval warfare has thus centered on a contest between those attempting to interrupt trade and those seeking to protect it. To

accomplish this objective in the formation of naval war plans, naval strategists were forced to deal with the vastness of the world's oceans, their accessibility to any nation desiring to make use of these oceans, and the fact that operations on the world's oceans were completely observable to anyone within range. These then, are the defining physical characteristics of the sea surface: vastness, accessibility and featureless terrain.

As school children, we learn that three-fourths of the world's surface is covered by water (seventy-one percent of the Earth's surface, to be more precise¹). It is difficult to mentally grasp the vastness this statistic implies unless one has experienced the effect of sailing the world's oceans without sighting land for weeks at a time. Historically, opposing fleets have often failed to find each other, even though both desired to engage in combat. When either fleet chose to avoid combat, the problem became infinitely more difficult. Rear Admiral A. T. Mahan described the sea as a "wide common, over which men may pass in all directions...."² From the dawn of Western history, sailing ships plied the seas conducting trade between widely scattered city-states.³ Given the need to move goods through this vast medium as efficiently as possible, great trade routes emerged. Chosen for ease of transit, access to enroute replenishment, and sometimes defensibility, these routes became the highways of the seas. Merchant vessels traversed these routes to the virtual exclusion of the remaining vast areas of open ocean as they conducted the interstate commerce that became ever more important to these nations. In so doing, they became lush targets for any with ill intent.

¹ *The Complete Reference Collection*, Electronic media (CD-ROM), (The Learning Company, Inc.: 1994, 1995, 1996, 1997)

² Alfred Thayer Mahan, *The Influence of Sea Power Upon History 1660-1783*, 5th ed., (1894; reprint, New York: Dover Publications, 1987), 25. Hereafter cited as "Mahan, *Influence of Sea Power*."

³ Thucydides, *The Landmark Thucydides*, ed. Robert B. Strassler using the 1874 translation by Richard Crawley (New York: The Free Press, 1996).

One of the great allures of the surface medium is its accessibility. Any nation with a shoreline has access to the vastness of the sea. Although geography determines the extent of access, Mahan describes the benefits as well as potential liabilities of access to the sea as follows: “Numerous and deep harbors are a source of strength and wealth, and doubly so if they are the outlets of navigable streams, which facilitate the concentration in them of a country’s internal trade; but by their very accessibility they become a source of weakness in war, if not properly defended.”⁴

In a corollary to the concept of vastness, the uniformity of appearance of the sea surface means that, once in range of detection, there is nowhere to hide. The “terrain” of the sea surface is utterly featureless. Arguably, navies throughout history have exploited this characteristic of the sea more than any other, as ships of the line took up positions within sight of enemy ports. By making their presence known, they offered the adversary two options: come out and fight, or stay in port and lose access to the sea. Achieving this presence carried with it associated costs, the most critical being a network of safe harbors or ports in which to refit equipment and rest crews. John Keegan in *The Price of Admiralty* attributes Nelson’s ability to eventually bring the French and Spanish fleet to battle at Trafalgar to the English stations in Malta.⁵ Similarly, Mahan identified the lack of remote “coaling stations” as a weakness in American naval power.⁶ Keegan also describes just how small the sea can become when a fleet is damaged and attempting to quit the battle. “A fleet heavily damaged by an opponent cannot count on topography to shield its retreat; unnavigable (*sic*) areas are few and, even if enlarged by minefields or

⁴ Mahan, *Influence of Sea Power*, 35.

⁵ John Keegan, *The Price of Admiralty: The Evolution of Naval Warfare* (New York: Penguin Books, 1988), 15-19.

⁶ Mahan, *The Influence of Sea Power*, 26-28.

the threat of submarine attack, offer nothing like the opportunity for effective rearguard action that rivers, marshes, forests and mountains do to a stricken military force on land.”⁷

The Subsurface Medium

The defining characteristic of the subsurface medium is concealment; the potential to operate undetected. The sea remains a vast, accessible medium offering the most efficient means of inter-state commerce, however the addition of the subsurface medium increases the vastness of the oceans by several orders of magnitude. This characteristic offers the submarine a freedom of maneuver unavailable to surface forces. Keegan describes the allure of submarines by saying, “The attractions of the submersible and the torpedo to weak naval powers need no elaboration. Here was a truly secret weapon, potentially deadly and physically undetectable (*sic*), which could reduce an overbearing surface fleet to impotence at negligible cost—provided always that the submersible and its torpedo could be made to work.”⁸ In other words, use of the subsurface medium allows forces to operate and either avoid or initiate contact with surface vessels at a time and place of their choosing. There are certainly constraints on this maneuverability. The water depth, salinity, temperature, and bottom terrain are but a few factors influencing the submarine’s potential maneuverability, but even the constrained maneuverability of a submarine is orders of magnitude greater than that available to surface ships due simply to the characteristics of operating in the subsurface medium.

⁷ Keegan, 124.

⁸ Keegan, 252-3.

Shaping Warfighting Theory

Rear Admiral Alfred Thayer Mahan, USN, had a tremendous impact on the theory of naval warfare as the epigraph opening this chapter makes clear. He was not, however, the only naval theorist writing on the topic. Sir Julian Corbett was a British academic who published shortly after Mahan, putting a slightly different twist on Mahan's ideas. The ideas of both merit our time and attention in our attempt to understand how the attributes of the sea medium helped shape warfighting theory. Following this discussion of the theorists, we examine WW I and the interwar years leading up to WW II to ascertain what the emerging potential to exploit the subsurface medium was saying to naval strategists. The final section in this chapter will examine whether anyone was listening.

Naval Theory.

Mahanian naval theory dominated the thinking of both US and Japanese naval planners as they prepared for WW II, thus it is important to understand the theory's basic elements. Alfred Thayer Mahan is best known for publishing *The Influence of Sea Power Upon History: 1600-1783* in 1890.⁹ In the introduction to *Mahan on Naval Strategy: Selections from the Writings of Rear Admiral Alfred Thayer Mahan*, editor John Hattendorf credits Mahan with two great contributions to naval thinking:

First, he linked maritime and naval activities to wider national and international issues. After his series of sea power books, students of naval affairs were no longer satisfied with mere descriptions of battles at sea, as they had previously been. They looked for wider implications and interrelationships. Secondly, he laid out a series of principles for

⁹ Mahan, *Influence of Sea Power*.

professional naval officers to use in the formulation of naval strategy. His adaptation and refinement of Jomini's approach to military science marked an intellectual revolution for navies; after reading Mahan's works, naval officers had found a tool with which they could develop strategic naval doctrine.¹⁰

Though unabashedly an advocacy piece for bolstering the size and power of the US Navy, Mahan's influence spread worldwide to include the British, Germans, Japanese, and certainly the Americans.

Mahan's basic premise was that inter-state commerce conducted across the seas was the basis of national power and, because of its importance, this commerce required the protection of the flag in the form of armed fleets.¹¹ In time of war, the most economical means to establish command of the sea (i.e. to enable your own commerce while denying the same to the enemy) was to seek out and destroy the enemy's battle fleet. In perhaps his most famous prescription for naval strategy, Mahan says: "This of course leads us straight back to the fundamental principles of all naval war, namely, that defence is insured only by offense, and that the one decisive objective of the offensive is the enemy's organized battle-fleet."¹² Once the threat to your own commerce was eliminated and command of the sea achieved, victory was assured. Mahan discounted the decisiveness of directly raiding commerce as it left the enemy's fleet free to do the same to your own commerce. He conceded the distress and harassment inflicted on an

¹⁰ Alfred Thayer Mahan, *Mahan on Naval Strategy: Selections from the Writings of Rear Admiral Alfred Thayer Mahan*, John B. Hattendorf and Wayne P. Hughes, Jr., eds. (Annapolis, Md.: Naval Institute Press, 1991), ix. Hereafter cited as *Mahan on Naval Strategy*.

¹¹ Mahan, *Influence of Sea Power*, 26.

¹² Mahan, *Mahan on Naval Strategy*, xxv.

adversary by commerce raiding but believed the results from history overwhelmingly reflected the inadequacy of such an approach.¹³

Writing some twenty years later, Sir Julian Corbett published *Some Principles of Maritime Strategy* in 1911 reaffirming Mahan's theory at its most basic point, namely that the need to protect commerce was the sole reason a battle fleet existed. However, he repudiated the idea that seeking out the other fleet and bringing it into a decisive engagement was the most effective method to achieve command of the sea. The reason a battle fleet existed, according to Corbett, was to provide commerce raiders the protection they needed to do their work. To achieve this objective, the battle fleet should take up positions along critical lines of communication (LOC) either by defeating the enemy controlling the LOC, or by seizing an uncontrolled LOC, then repelling any force that challenged that control. A decisive fleet engagement was certainly a viable way to ensure this protection, and given the importance of commerce to national survival, strategist must both anticipate and plan for this eventuality. However, if the opposing force ceded control by declining battle, the desired effect was still achieved without engaging in large fleet battles.¹⁴ In other words, Corbett proposed a theory where large fleet engagements may be necessary, but only to achieve the broader objectives of interrupting the adversary's trade. It is difficult to assess Corbett's impact on the theory of the times as anything other than negligible. Naval leaders talked about interrupting wartime shipping, but as we shall see in the following paragraphs, talk is often just that—talk.

¹³ Mahan, *Influence of Sea Power*, 481.

¹⁴ Sir Julian S. Corbett, *Some Principles of Maritime Strategy* (1911; reprint, Annapolis, Md.: Naval Institute Press, 1988), 115.

WW I, Treaties, and the Interwar Years.

The results of submarine warfare in WW I might also have provided planners insights into how operating in the subsurface medium was beginning to shape naval warfighting theory. While Japan had no direct experience with the war in the Atlantic, they were then and for a time afterwards allies with Britain who shared much of its naval technology (including submarines) with them. The US did have direct experience with the conflict, yet many in the US Navy believed the advent of the aircraft carrier and the invention of what would become sonar meant submarines were obsolete.¹⁵ The logic of this argument is inextricably bound up in acceptance of the Mahanian decisive battle as a given. From this frame of reference, submarines observable by naval aircraft or detectable with sonar are “obsolete” in a decisive fleet battle. This despite the fact that, except for the Battle of Jutland, there were no significant fleet engagements in WW I. In terms of Mahanian theory, “decisive engagement” is simply inappropriate to describe what transpired at Jutland. If anything, the battle validated Corbett’s contention that the purpose of the fleet is to control LOCs against the depredations of the opposing fleet. The Royal Navy was ready and willing to engage in decisive combat, but just as willing to accept the German High Seas fleet remaining in port.¹⁶

The submarine war in the Atlantic was potentially even more instructive. Rear Admiral William S. Sims was the first US naval officer sent to London shortly before American entry into the war and, soon after arriving, notified US leadership of the gravity of the situation. According to George Baer, “In April 1917, it looked as though the 40 German submarines on station in the western approaches to the British Isles would starve

¹⁵ Clay Blair, *Silent Victory* (New York: J.B. Lippincott Co., 1975), 49.

¹⁶ Keegan, 124-5.

the British into submission. Germany had wrested use of the sea from Britain with little submarines, not with great battleships.”¹⁷ Germany’s success in submarine warfare offered lessons to any nation interested in an objective assessment. Blair states unequivocally, “The U-boat threat was neutralized, not defeated.”¹⁸ In support, he cites some telling statistics. The Germans had more boats in service at the armistice than were destroyed during the war (178 versus 179) with over two hundred twenty in various stages of construction. For every U-boat lost, thirty-two allied ships were sunk.¹⁹

Treaties. Perhaps most illustrative of the as yet little understood potential impact of the emerging subsurface medium on naval strategy was the United Kingdom’s attempts to outlaw submarines at every opportunity following the conclusion of WW I. To emphasize the point, at the time of the Washington Naval Conference in 1922 following Germany’s disarmament, Britain was the acknowledged world leader in submarine, torpedo, and sonar technology, in addition to having the greatest number of vessels, and yet they were adamant about abolishing the submarine.²⁰ Clay Blair, in his book *Silent Victory*, offers an insight as to why this might be so:

There were several reasons behind the British proposal. Britain was still an island empire, dependent on sea commerce for survival. She had suffered enormously from the submarine and might again suffer in the future. Her navy was still the largest. It too had suffered serious damage from the submarine. It could happen again.”²¹ Both the US and France opposed abolishing submarines, according to Blair, because of their unparalleled defensive capabilities in far-flung reaches of the globe.²²

¹⁷ George W. Baer, *The US Navy, 1890-1990: One Hundred Years of Sea Power* (Stanford, Calif.: Stanford University Press, 1994), 67.

¹⁸ Blair, 45.

¹⁹ Blair, 45.

²⁰ Blair, 51

²¹ Blair, 49.

²² Blair, 51.

In 1930, the world's naval powers met in London to begin negotiating to extend the restrictions implemented by the Washington Conference due to expire in 1936. Once again, Britain proposed abolishing submarines in total; once again, the proposal was defeated by the lesser naval powers citing the submarine's ability to defend against large fleets.²³ An important undercurrent to the London conference—an issue that was indicative of US naval strategy—involved arguments over the types of ships to be restricted. The US delegation argued for parity with Great Britain in capital ships, but strict constraints on smaller commerce-raiding shipping. As George Baer describes it, there was an ulterior motive.

The (US) Navy's real interest was in preparing for a war with Japan. It talked about defense of trade and the need to meet armed merchantmen when what it really wanted was to increase its Pacific force. The bottom line for most officers was parity with Britain in overall cruiser tonnage and a favorable ratio with Japan—namely the 10:10:6 formula—and, with the exception of heavy cruisers with 8-inch guns, no limit on the number of ships that each state could build within the tonnage limit for each class.²⁴

In point of fact, only the British—the nation that suffered the effects of WW I commerce raiding—actively pursued restricting the ship types best suited for unrestricted warfare. Other nations focused on capital ships and “parity” with their rivals.

Germany's pre-WW II treaty effort and subsequent naval construction graphically illustrates the pervasiveness of Mahanian theory. Disgraced and disarmed following their WW I defeat, Germany did not participate in the above-mentioned naval conferences, however they did sign a bilateral agreement on submarine tactics with the British in 1936.

²³ Blair, 59.

²⁴ Baer, 110.

This treaty specifically required submarines to surface, warn, and board unescorted merchant vessels; unannounced attacks were only permissible if merchantmen were escorted by warships.²⁵ Having signed this treaty, German naval construction emphasized creation of the High Seas Fleet battle fleet at the expense of U-boats. As a result, Germany would field only one hundred of the estimated three hundred submarines deemed necessary at the start of WW II to starve Britain into capitulation.²⁶

Interwar Years. When one reviews interwar naval history, it is interesting to note how frequently authorities referred to submarines in terms of defensive capabilities. How the strategists of the time reconciled “defensive capabilities” with the performance of German U-boats in WW I is indeed difficult to fathom. One plausible explanation is that naval planners failed to see the potential of the medium because they were caught in the technology of the times: they failed to see the forest for the trees. In the US, coastal defense was viewed as the submarine’s most appropriate mission because it was essentially the only mission they were capable of performing.²⁷ From general seaworthiness, to propulsion, to diving ability and submerged maneuverability, US systems in the inter-war years were at best marginally capable. Murray and Millet document the US struggle to improve submarine capabilities at great length with a single message ringing through quite loudly: the US wanted a submarine capable of operating with the fleet in support of Mahanian fleet-level engagements.²⁸ When they failed to get what they wanted, the resulting pariah was shuffled off to a lesser mission without ever considering what effects the submarine might achieve independent of the fleet.

²⁵ Keegan, 261.

²⁶ Keegan, 262.

²⁷ Williamson Murray and Allan R. Millet, *Military Innovation in the Interwar Period* (Cambridge: Cambridge University Press, 1998), 252.

Japanese input was conspicuously absent from the discussion of submarine defensive capabilities. In point of fact, the Japanese developed a submarine strategy aimed at long-range surveillance of enemy ports to establish contact with the battle fleet when it sortied in support of their overall Mahanian surface strategy. Surprising, as it may seem, the Japanese were even more Mahanian in their strategy than the Americans. As described by David Evans and Mark Peattie in their outstanding work documenting the Imperial Japanese Navy, the Japanese received disconcerting results when they began training in 1938 to implement their fleet surveillance and close-in attack strategy—their strategy did not work due in large part to the limited capabilities of the submarines employed.²⁹

Both the US and Japanese navies suffered from what can best be described as a type of schizophrenia as they attempted to understand how the attributes of the subsurface medium should shape their existing theory. Both continued to spend scarce resources on submarines even though neither had any clear strategy for their employment, attempting to seize an advantage by exploiting the concealment the new medium offered. Both envisioned sending their submarines into heavily defended regions under the control of the enemy and, when opportunity presented itself, to attack the enemy fleet—while the submarine was alone and cut off from support. When the submarine demonstrated it was incapable of making any significant contribution to the destruction of the enemy fleet when employed in this manner, planners relegated it to coastal patrol. In the final analysis, it is clear strategists saw the submarine solely in terms of its ability to support a specific *means* (i.e. decisive surface battles) rather than grasping the broader implications

²⁸ Murray and Millett, 254-264, and Blair, 23-58.

²⁹ David C. Evans and Mark R. Peattie, *Kaigun: Strategy, Tactics, and Technology in the Imperial Japanese Navy, 1887-1941* (Annapolis, Md.: Naval Institute Press, 1997), 428.

of how this emerging capability to exploit the subsurface medium might be employed to achieve the overall objective.

In summary then, existing Mahanian naval theory emphasized exploiting the attributes of the surface medium and the emergence of the potential to exploit the subsurface medium had little actual effect on this theory. Subsequent chapters will illustrate that a very small minority within both the US and Japanese navies were advocating a change, but Mahanian theory prevailed. However, the purpose Mahan originally ascribed to this prescription was lost in the zeal to engage in offensive, surface combat. The German exploitation of the subsurface medium during WW I as well as the subsequent British attempt to outlaw submarines foreshadowed both the importance and the applicability of subsurface warfare to naval theory. Both the US and Japanese navies, however, simply added submarines as another tool in decisive battle-fleet engagement planning. Given the technology of the times, planners relegated the submarine to minor missions because they judged it incapable of making significant contributions to this primary role. The only task remaining before looking at how these theories played out in WW II is to determine whether the characteristics of the subsurface medium were in fact relevant to surface warfare theory.

Relevance to Existing Theory

The previous sections have demonstrated the length to which planners had come to confuse the ends and means in the naval warfare theory Mahan originally envisioned. In the drive to engage the enemy fleet in offensive combat, the objective of defeating the adversary had come to equal the destruction of his fleet. Lost in this interpretation was Mahan's underlying justification for the existence of armed shipping. To quote directly,

Mahan said: “The necessity of a navy, in the restricted sense of the word, springs, therefore, from the existence of a peaceful shipping, and disappears with it...”³⁰ Given this understanding, the question, “Were the differences in the second medium (i.e. “concealment”) relevant to existing theory?” must be addressed both in terms of “pure” Mahanian theory as well as naval theory of the times.

Command of the Sea

The goal of Mahanian theory was to achieve command of the sea through decisive fleet engagements and thereby gain the ability to strangle the enemy’s maritime commerce. Mahan’s theory of decisive surface engagement required two basic ingredients: the mutual consent to do battle by both fleets and the acceptance of damage to the ships so engaged. Both ingredients spring from the characteristics of the surface medium. With the vastness and accessibility of the sea, a fleet that wished to avoid battle was almost certain to achieve its goal. Nelson amply demonstrated this assertion in the over two-year period he spent trying to bring the French and Spanish fleets to battle before Trafalgar. However, with the featureless “terrain” of the sea, once battle is joined, damage to ships of both fleets is virtually certain. Strategists recognized that victory most often went to the fleet that started with the greatest numbers of heavily armed ships and who suffered the least during the battle itself, hence the drive to produce the great battleship fleets.

The nature of combat in the subsurface medium is diametrically opposed to that of surface warfare. Properly exploited, the concealment characteristic of subsurface operations provides the submarine the initiative to commence or decline combat

³⁰ Mahan, *Influence of Sea Power*, 26.

completely independent of opposing forces. Additionally, the inherent lethality of the subsurface medium to human beings places an extremely high premium on the structural integrity of the vessel. A minimal amount of damage to the submarine places it in immediate peril. Whether structural damage results in the submarine being sunk, the elimination of concealment by forcing it to operate on the surface, or the reduction of concealment by causing it to generate detectable signals if it remains submerged, the casual acceptance of damage is anathema to exploitation of the subsurface medium.

Viewed from the perspective of the prevailing naval theory of the times, the characteristics of the subsurface medium were entirely relevant to existing theory. Submarines no longer required the consent of the opposing vessels to initiate combat nor could they accept structural damage as the cost of normal operations, the two pillars of Mahanian fleet engagement theory. This conclusion raises the question of whether the submarine, if employed to better exploit the tactical characteristics of the subsurface medium, could have achieved greater effect in support of the objective—strangling maritime commerce. In the end, proper employment of the submarine rendered destruction of the opposing fleet unnecessary resulting in an unequivocally affirmative response. In what must have been a tremendous irony for American submariners during the inter-war years, Brigadier General William “Billy” Mitchell made a very similar argument in 1925:

It is conceivable and probable that there will be a long period of hostilities before any surface fleets come into action. The weaker surface fleet would certainly retreat to the protection of its air power in the radius of aircraft action of its own coast. The superior fleet menaced by submarines and long distance aircraft could not long exist on the high seas and would

be of little service there under such conditions. A fleet action in the old sense may never occur again.³¹

Mitchell as was his wont, argued for an independent mission for the submarine separate from the fleet, and argument history has shown certain validity. However, even as part of a surface fleet action, the characteristics of the subsurface medium offered capabilities that might well have been synergistic with surface theory. Unfortunately these synergies were many years in the future.

Mitchell's vision for the employment of the submarine also illustrates another point of relevance between surface and subsurface theory, namely the defense of fleets from the submarine "menace." Existing naval theory had absolutely nothing to say about defending against a subsurface threat exploiting concealment in attacking the fleet. The capital ship's perceived invulnerability to submarines was definitely not a result of any perceived ability to survive a torpedo attack. On the contrary, naval officers universally regarded the torpedo as a deadly weapon. Though not launched by submarines, Keegan simultaneously describes the result of multiple torpedoes suddenly appearing amongst an attacking fleet during the battle of Jutland and the truth of Mahan's "both fleets must desire combat" theoretical pillar. "Nevertheless twenty-one torpedoes traveled the distance, forcing Jellicoe to order a general 'turn-away' and individual ship captains to manoeuvre sharply. No hits were scored, but by the time Jellicoe resumed his pursuit Scheer had put himself some ten to eleven miles from the Grand Fleet, comfortably out of range, and was heading south for home..."³² Generally speaking, navies considered the threat to capital ships from submarines to be minimal because they believed various

³¹ William Mitchell, *Winged Defense: The Development and Possibilities of Modern Air Power, Economic and Military* (1925; reprint, Toronto: General Publishing Company, Ltd., 1988)

³² Keegan, 149.

antisubmarine efforts were highly efficient.³³ Unfortunately, this again ignored the lessons of WW I. As Blair relates,

The single most effective offensive weapon against the U-boat—statistically speaking—turned out to be the submarine. During the war, there were an average of 35 Allied submarines on full-time patrol against the U-boat. This small force sank 18 U-boats—twice as many as the celebrated Q-ships and three times as many as the 625 aircraft and blimps assigned to antisubmarine warfare.³⁴

While the effectiveness of submarines against major warships was open to debate, the efficacy of antisubmarine techniques was much less so. Given the survivability of capital ships from submarine attack was predicated on effective antisubmarine techniques and equipment, WW I offered clear warnings for future naval combat, yet were ignored in any case.

Decisive Fleet Battles—Or Not...

In the dogmatic acceptance of Mahan's dictum to seek and engage in decisive fleet battle, neither the US nor Japan questioned Mahan's basic assumptions on which he based his prescription. Thus, in the period leading up to WW II, neither reconsidered their strategy in light of the concealment offered by the subsurface medium and the resulting freedom of maneuver offered to the submarine. Mahan argued commerce raiding might indeed cause pain to a nation's shopkeepers or degrade the national treasury somewhat, but could see no discernible impact on a nation's ability to conduct a war.³⁵

³³ E.B. Potter, *Sea Power*, 2nd ed. (Annapolis, Md.: Naval Institute Press, 1981), 257.

³⁴ Blair, 45.

³⁵ Mahan, *Influence of Sea Power*, 539.

Unfortunately for naval strategists, times had changed, fundamentally altering a nation's reliance on inter-state commerce. Starting before the turn of the century with acceleration of the industrial revolution and illustrated by Britain's near-collapse through commerce attrition in WW I, reliance on maritime shipping reached a pinnacle in WW II. Modern, highly mechanized military forces and their supporting societies had reached a point of utter dependency on raw materials for producing steel, ammunition, and petroleum products for combustion engines. Many historians assess the US embargo of steel and petroleum products as a critical element in the Japanese decision to initiate hostilities with the US. While richly blessed in strategic natural resources in the continental US, moving the finished products into the Pacific war zone required the US to transport vast quantities of men and material across the great expanse of the Pacific ocean—by sea. Both sides were, therefore, vulnerable to any disruption of transport shipping between the war zone and their home ports or sources of supply. Corbett, describing the submarine warfare of WW I, called it “the greatest sea fight in history,” and yet no fleets ever engaged in the Atlantic.³⁶ Blair concludes, “The emergence of the submarine demanded a whole new range of naval planning. Contrary to doctrine of the past, the *guerre de course* would now have to be considered a potentially decisive method of waging war.”³⁷

As we have seen, the “new range of naval planning” did not occur during the interwar years. The warfighting potential of a submarine is almost completely a function of its ability to operate undetected; efforts to understand the subsurface medium should have maximized one's ability to either defend against or exploit the range of capabilities

³⁶ Sir Julian S. Corbett as quoted by Blair, 45.

³⁷ Blair, 45.

resulting from remaining concealed. The fixation on attempting to attain a surface speed of at least seventeen knots in order to keep pace with the fleet pushed the ability to safely achieve deeper dives off the list of priorities. The submarine technology of the period required frequent periods of surfaced operations, yet something as simple as developing an effective camouflage paint scheme to enhance concealment during surfaced operations escaped the attention of naval planners and designers until well into WW II.³⁸

The most striking example of this failure to consider the characteristics of the medium is the ongoing development of the torpedo. As Keegan's earlier quote made clear, even the staunchest battleship captain considered the torpedo a potent threat. US development efforts centered around the steam torpedo capable of carrying a heavy explosive at great speed and distance. Lost in this development was the understanding that a steam torpedo necessarily leaves a wake leading directly back to the launching vessel. To the surface combatant, this consideration is absolutely irrelevant; to a submarine attempting to exploit the stealth and surprise inherent in the concealment provided by the subsurface medium, this consideration might well spell doom. On the surface, ships were obviously aware they were engaged with the enemy, hence high-speed weapons were desirable to reduce the time available to maneuver and avoid the torpedo. In the context of subsurface warfare, protecting the concealment of the attacker promised significantly greater effects than any increase in speed might afford. As a submarine's primary weapon, high reliability was essential. Torpedo reliability was much less vital to a surface combatant relying primarily on large-caliber naval gunfire for offensive punch. US efforts were abysmal in this area, as Chapter 3 will illustrate. In contrast, Chapter 4 will illustrate that, despite having the world's best torpedo at the start

³⁸ James F. Derose, *Unrestricted Warfare* (New York: John Wiley & Sons, Inc., 2000), 172.

of the war, Japan never considered any submarine employment options other than fleet engagements.

Though the surface and subsurface media share the sea as a common element, the inevitable conclusion resulting from the preceding analysis is that the characteristics of the two media are starkly different. The surface medium rewards the nation that achieves positional dominance over an adversary, reducing the vastness of the sea to a more controllable space where battle-fleets may engage or decline battle as they choose. The dominant fleet is then able to exert its will over the adversary by stifling commerce and bringing economic ruin to the vanquished. The emerging ability to operate in the subsurface medium brought concealment and a completely new freedom of maneuver never before enjoyed by naval forces at the cost of a much greater reliance on the technology making that concealment possible. Germany's exploitation of the subsurface medium during World War I foreshadowed the impact the submarine would have on naval strategy. This, coupled with the unremitting demand of the British to outlaw the submarine in the inter-war years, demonstrates unequivocally the relevance of the emerging potential to exploit the subsurface medium to the existent naval theory.

As the quote from Corbett makes clear, a new way of thinking was required. This was not to be as Mahanian theory for decisive fleet battles reasserted itself in the interwar years. Naval planners ignored WW I results, making unsubstantiated assumptions about the efficacy of antisubmarine capabilities and the resultant obsolescence of the submarine as an instrument of war. Planners and developers became fixated on forcing the submarine into Mahanian theory rather than attempting to maximize the ability to exploit the emerging capabilities of the subsurface medium. The question remaining is whether

Mahanian theory could adequately guide naval commanders in their efforts to employ submarines in war. Strategists on both sides of the Pacific would have their answer when the US and Japan went to war, but only one side would get it right.

Chapter 3

U.S. Employment of Submarines in WW II

Yesterday, December 7, 1941 – a day that will live in infamy – the United States of America was suddenly and deliberately attacked by naval and air forces of the Empire of Japan.

— Franklin D. Roosevelt

US Naval planners missed many opportunities to better prepare their forces prior to the initiation of hostilities because they simply failed to recognize the opportunities for what they were. Admittedly, the advantage of sixty years of study and scholarship grant a clarity of vision not possible to those involved in the decisions of the day and is precisely the reason why close examination is potentially so beneficial. If we can identify how to recognize opportunities, our chances of not repeating the mistakes made prior to WW II are presumably much greater.

Accommodation or Creation: A Question of Theory

Six hours after the Japanese attack on Pearl Harbor, the Navy Department issued the following message: “Execute unrestricted air and submarine warfare against Japan.”¹ With this order, US submarine forces began conducting warfare with inappropriate Mahanian theory and surface warfare doctrine and very little directly applicable training. The US plan for war against Japan, Rainbow 5, the most recent iteration of War Plan Orange (WPO) some thirty years in the making, was put on indefinite hold as the nation began the long process of rebuilding the fleet necessary to execute its dictates. In the

¹ Clay Blair, *Silent Victory* (New York: J.B. Lippincott Co., 1975), 106.

interim, the twenty-nine submarines of the Pacific and Asiatic Fleets were thrown into the breach. The resulting war against shipping was, according to the US Strategic Bombing Survey, "...perhaps the most decisive single factor in the collapse of the Japanese economy and the logistic support of the Japanese military and naval power."²

Existing Theory and Doctrine

War Plan Orange, originally drafted following the conclusion of WW I, existed in some two dozen iterations as it evolved into the Pacific Theater portion of the Rainbow 5 plan for the conduct of WW II according to Edward R. Miller in his authoritative book *War Plan Orange: The US Strategy to Defeat Japan, 1897-1945*.³ Because this plan captured the essence of Navy thinking on how to conduct the war in the Pacific, Miller's synopsis of the plan warrants an extensive quote:

Distance and geography dictated a three-phase contest. In Phase I, Japan would seize the lightly defended American outposts and assure itself of access to the oil and raw materials of territories to the south and west. The US Navy, concentrated at home ports, would be unable to prevent these takeovers but could mobilize in the eastern Pacific, which was considered a sanctuary despite the possibility of hit-and-run raids.

In Phase II, Blue (US) expeditions spearheaded by superior naval and air power would steam westward. Intense but small-scale battles would procure Japanese islands of the central Pacific. Advanced naval and air bases would be established and supply lines secured. Japan would resist with expendable forces, trading distance for time and erosion of the attacking fleet, but the United States would gradually win the attrition battles. After two or three years it would regain a base in the Philippines. A progressively tightening blockade would sever Japanese ocean trade. At a time and place of Japan's choosing, the two battle fleets would meet in a cataclysmic gunnery engagement which American dreadnaughts would win.

² US Strategic Bombing Survey, *The War against Japanese Transportation, 1941-1945* (Washington: US Government Printing Office, 1947), 6.

³ Edward R. Miller, *War Plan Orange: The US Strategy to Defeat Japan, 1897-1945* (Annapolis, Md.: Naval Institute Press, 1991), 2.

In the war's third phase Japan's insularity would prove fatal. American forces would advance northward through islands paralleling the coast of Asia to establish new bases for economic warfare. They would choke off all of Japan's imports and ravage its industries and cities by air bombardment until it sued for peace, even though its proud army stood intact in the home islands and in China.

Clearly, Phase III of this plan identified what the US Navy considered their primary contribution to accomplishing the defeat of Japan: choking off imports. Phase II identified a "progressively tightening blockade" but did not consider it sufficient to achieve victory, postulating a "cataclysmic gunnery engagement" would first be necessary. In fact, a blockade of sorts was imposed by submarines almost immediately, becoming increasingly effective with time and, despite two years of grossly malfunctioning torpedoes, eventually succeeded in destroying 60% of the total shipping tonnage sunk by war's end.⁴

Yet, this success did not come easily. Mahanian theory proved inadequate for guiding the US Navy's efforts to exploit the subsurface medium. Two aspects of War Plan Orange (WPO) illustrate these inadequacies. First, the plan made no provisions for offensive submarine warfare independent of fleet operations even as late as 6 Dec 41. Second, WPO made no concession to the vulnerability of US military power in the western Pacific resulting from the extended maritime supply routes necessary to deploy and employ this power. In the days and months following the attack on Pearl Harbor, US military power was perhaps even more vulnerable than Japan's to an interruption in transport shipping. These inadequacies are even more astounding given US experience in the ongoing Battle of the Atlantic. The Americans knew German submarines threatened the survival of Britain despite tremendous efforts to slow their progress. In short, the US

⁴ Miller, 352.

had experienced both the effects of an enemy's successful submarine offensive and the difficulty in defeating such an offensive, yet none of this knowledge or experience was applied to plans for conducting naval warfare in the Pacific. Understanding submarine planning considerations and US strategic vulnerability to submarine attack will help explain how US Navy planning entered WW II in this deplorable condition.

Submarine Planning Considerations

In the late 1920's and early 1930's, the Navy General Board examined the performance of the newest, most advanced US submarines and recommended that submarines not be incorporated into fleet operations.⁵ The recommendation rested largely on the inability of these boats to perform reliably at the necessary speed of the surface fleet, but also reflected the growing perception that submarines were simply obsolete due to the combination of active sonar and aircraft surveillance. Navy planners eventually implemented this recommendation in Rainbow 5 after further exercises and testing revealed the problems remained even with the fielding of the next generation (the *Salmon* class) of submarines. As Blair relates:

Under WPO...the fleet boats were finally excluded from direct—and close—operation with the fleet. They would serve as long-range scouts in distant Japanese waters and off the exposed islands of Midway and Wake and the Japanese-held Marshalls, serving to report Japanese fleet movements, to attack enemy capital ships and other targets, and to perform special missions as directed by the commander in chief of the US fleet.⁶

In summary then, the attitude of US Naval planners was to ask the question, “How can submarines best help attain fleet objectives,” with their answer being “they cannot.” Perhaps a question such as “How can submarines best help attain national objectives”

⁵ Blair, 57.

would have been more appropriate and might have led to a clearer understanding of how submarines could indeed become one of the primary tools for defeating Japan.

With this broader question in mind, US planners might have averted their failure to consider the lessons being learned in the Battle of the Atlantic for application in the Pacific theater. This failure was certainly not due to underestimating the gravity of the situation. Kenneth Hagan quotes General George C. Marshall remarking in November 1940, “If we lose in the Atlantic, we lose everywhere.”⁷ The architect of the German U-boat offensive was Captain Karl Dönitz, who viewed unrestricted submarine warfare as potentially decisive in the attempt to starve Britain into submission.⁸ By all accounts, he almost succeeded. Winston Churchill announced the Battle of the Atlantic on 6 March 1941 and is quoted by Richard Overy as regarding it “as the real issue of the war” for Britain.⁹ Offensively, German “wolf pack” tactics employing multiple submarines in night attacks at a “decks awash” depth proved devastating to allied merchant shipping.¹⁰ Defensively, Potter makes it clear that advanced ship- and airborne radar coupled with enhanced intelligence on the position of the wolf packs through direction finding and code-breaking were the keys to mitigating the German threat.¹¹ Unfortunately, neither of these lessons were seriously considered for application in the Pacific until well after the start of the war.

No weapon is foolproof or invulnerable to countermeasures, the submarine included. The lesson waiting to be gleaned from the Atlantic experience emphasized concealment:

⁶ Blair, 76.

⁷ Kenneth J. Hagan, *This People's Navy: The Making of American Sea Power* (New York: The Free Press, 1991), 292.

⁸ Keegan, 296.

⁹ Richard Overy, *Why the Allies Won*, (New York: W.W. Norton & Company, 1995), 31.

¹⁰ Keegan, 297.

¹¹ E.B. Potter, *Sea Power: A Naval History*, 2nd ed. (Annapolis, Md.: Naval Institute Press, 1981), 261.

the critical characteristic of the submarine derived by exploiting the subsurface medium. With it, the submarine was highly lethal against merchant and armed shipping. With the cloak of concealment lifted by foreknowledge of position or exposure to radar, the submarine was a difficult, but solvable, nuisance. In other words, US planners should have known that submarines were effective operating independent of the fleet if able to operate undetected as well as what activities led to submarine detection. In addition, US planners did know that Japanese radar technology was in its infancy while Navy cryptographers were making great advances in breaking Japanese naval codes. However, no concerted effort to combine this knowledge into potentially strategic effects was evident until well into the war.

US Strategic Vulnerability to Japanese Submarines

In terms of US vulnerabilities, the clearest example of the inability to integrate the differences of the subsurface medium into naval planning is the sanctuary assumption. The fact that US planners envisioned using the eastern Pacific to mobilize US fleets – to treat it as a sanctuary – illustrates the degree to which submarine capabilities figured in planning efforts. The justification for this assumption given Japan's near two-to-one numerical superiority in ocean-going submarines at the start of hostilities coupled with the performance of German U-boats in the Atlantic, is indeed difficult to understand.¹²

The fact that Japan never exploited this vulnerability does not diminish the risk associated with the war plan, especially in light of an essentially correct assessment of Japanese strategic objectives and the losses inflicted by German U-boats off the Atlantic coast within six months of American entry into the war. US planners envisioned Japan's

¹² Potter, 331.

strategy to be twofold: to seize the “southern resource area” quickly before US mobilization, followed by aggressive forward defense designed to inflict maximum cost on the Americans, resulting in a negotiated settlement when the US grew tired of the expense.¹³ Early in WPO drafting, planners wondered whether the economic strangulation they planned to implement would drive the Japanese to unrestricted submarine warfare, inducing the US to follow suit. They apparently never considered the alternative that the Japanese would follow the US example.¹⁴ War gamers at the Naval War College, however, were convinced Japan would resort to unrestricted warfare.¹⁵ Unfortunately, planners failed to incorporate their convictions on this subject into WPO. The potential magnitude of submarine-inflicted losses was apparent in the success achieved by the Germans between January and June of 1942: over 600,000 tons sunk by an average of five submarines on station.¹⁶ This in an area ostensibly organized for war for at least two years. The hypothetical costs a determined Japanese submarine offensive might have inflicted in an area considered a “sanctuary,” while undeniably counter-factual, are staggering.

In terms of Drew’s “tree of doctrine” analogy introduced earlier, the US Navy entered WW II with fundamental theory and surface warfare environmental doctrine derived from Mahan’s prescription for decisive fleet engagements. The beginnings of subsurface theory were evident among a few American submariners, however the naval

¹³ Miller, 27-28.

¹⁴ Miller, 152 and 319-320.

¹⁵ Holger H. Herwig, “Innovation Ignored: The Submarine Problem,” in *Military Innovation in the Interwar Period*, eds. Williamson Murray and Allan R. Millett, (Cambridge: Cambridge University Press, 1996), 253.

¹⁶ Dönitz in fact wanted to send twelve U-boats to operate off the American coast. The possible impact of this larger deployment is indeed interesting to consider given the more or less negligible antisubmarine efforts of the time. John Keegan, *The Price of Admiralty: The Evolution of Naval Warfare*, (New York: Penguin Books, 1988), 270.

bureaucracy paid scant attention to these Mahanian-theory dissenters. What little theory was evident never approached the status of doctrine in that it was not being taught and, when implemented, required intensive efforts to disseminate to practitioners. Given the inability of submarines to support surface fleet doctrine and the non-existence of subsurface doctrine, US submarine commanders were left to employ tactics repeatedly demonstrated as ineffective and that failed to capitalize on the concealment of the subsurface medium.

While naval leaders of the times did not speak in terms of operational effects and media, their words and actions indicate that they believed the surface and subsurface sea media, though containing environmental differences, were an indivisible operational medium. The attack on Pearl Harbor and decimation of the US Pacific battle fleet resulted in the driving need to further develop naval theory to exploit the subsurface medium. Through trial and error as well as a determined effort to disseminate successful doctrine and tactics, US submarines eventually claimed their place as perhaps the greatest contributor to Japanese defeat. While counter-factual, it appears quite probable the US would not have pursued the creation of subsurface theory and doctrine without the impetus of losing the battle fleet. Also instructive is the fact the US did not revert to its original WPO surface doctrine for submarines when the surface fleet forces were again available to implement the “decisive engagement” doctrine. Instead, the submarines continued aggressively pursuing their new environmental doctrine up to the time of Japanese capitulation while simultaneously integrating their operations into the operations of the surface fleet.

Contextual Influences

People do not make decisions in a vacuum. The above analysis seems to clearly support the need to develop independent subsurface naval theory, yet the US decided against this course of action. Two critical influences are largely responsible for this supporting this decision in favor of retaining dogmatic acceptance of Mahanian decisive engagement theory: the status of unrestricted submarine warfare in international law, followed closely by the relatively limited technology of the times. The first served to constrain the idea of an independent, offensive submarine mission while the second made submarines only marginally capable of supporting existing doctrine and therefore not worth the time or effort.

More than any other influence, the various treaties to which the US was a party conditioned and reinforced the way naval planners thought. This thought process directly contributed to their collective failure to sense the shift in naval warfare the submarine portended until some time well after the attack on Pearl Harbor. This is not to minimize the effects of isolationism, anti-war sentiment, force reductions, and declining budgets; all of these constrained naval planners. However, Congress provided funds and the US built ever-improving submarines despite these influences. Conversely, the perceived restrictions of interwar naval treaties was pervasive, relegating discussion of the submarine's commerce raiding potentialities to the darkest of back rooms. As is often the case, however, conventional wisdom vastly overstated the restrictions on submarine warfare, regardless of the degree to which naval planners held it to be true.

The US population universally loathed German employment of unrestricted submarine warfare in WW I as an inhumane practice.¹⁷ Support was very strong in the US to outlaw the practice in the arms limitation treaties negotiated in the interwar period. Policy makers and naval leaders were, however, more pragmatic. The first opportunity was the Washington Naval Treaty of 1922 where the British tried unsuccessfully to outlaw the submarine entirely. Failing that, US Senator Elihu Root proposed verbiage effectively rendering the submarine impotent for commerce raiding by requiring adherence to the established rules of surface warfare. Submarines would be required to surface and provide safe passage to non-combatants before seizing or destroying a merchant vessel. The General Board of the US Navy opposed this verbiage, arguing the submarine was “an effective and legitimate weapon of warfare.”¹⁸ The Root language failed to garner sufficient support and was defeated. Blair summarizes the conference’s impact on submarines as follows: “When the conference broke up, all nations were legally at liberty to build as many submarines as they pleased and to employ them in wartime however conscience dictated.”¹⁹

Meeting in London during 1930, the maritime powers strove to extend the Washington restrictions beyond the already once-extended date of 1936.²⁰ Again, Britain unsuccessfully attempted to ban submarines entirely, their proposal vigorously opposed by both France and the US. This time, however, the General Board did not oppose the Root verbiage. Its policies restricting submarine tactics survived and were included in

¹⁷ Blair, 49.

¹⁸ Blair, 51.

¹⁹ Blair, 52.

²⁰ The original 10-year expiration date (1932) was extended by the 1927 Geneva Naval Conference called by US President Calvin Coolidge to extend naval tonnage restrictions to “lesser naval types” such as destroyers and corsairs. This effort to expand the restrictions failed, but the existing “capital ship” restrictions were upheld. See Potter, 235.

the final agreement. The problem with this treaty was that only Great Britain, Japan and the US signed the agreement.²¹ Potter succinctly sums up the net effect of international naval treaties saying, “For all intents and purposes, treaty limitations of navies expired 31 December 1936.”²²

The literature does not provide a clear explanation for the General Board’s shifting position on the restricted use of submarines contained in the Root language between 1922 and 1930. It seems plausible to conclude the shift resulted from the perception within the US Navy that submarines were ineffective offensive weapons and thus restrictions were acceptable. As previously addressed, the General Board had recommended in 1928, based on poor performance in fleet exercises, abandoning the idea of incorporating the submarine into fleet operations. Inescapable in this conclusion is the role played by unquestioned, dogmatic application of Mahan’s prescription for decisive fleet engagements. “Secretary of War Henry L. Stimson only slightly exaggerated the navy’s cultural framework when he commented that it had a particular psychology, according to which ‘Neptune was God, Mahan his prophet, and the United States Navy the only true church.’”²³ The emphasis of the various treaties on capital ships, treating submarines and other “lesser naval units” as an afterthought, was as much a reflection of naval strategy as it was an attempt to constrain a naval arms race. Lost in it all were the potential effects exploitation of the subsurface medium might yield if freed of the controlling surface warfare doctrine.

²¹ Hagan, 278.

²² Potter, 235.

²³ Herwig, 254.

Operational Impacts Resulting from Decision

The US failure to develop theory and doctrine to exploit the subsurface medium had operational impacts in WW II. A useful means to understand the importance of these impacts is to examine first the observed effects and then the potential effects not realized.

Effects Observed

When the order went out to US forces to conduct unrestricted air and submarine warfare against Japan within hours of the attack on Pearl Harbor, one truly staggering problem became evident: WPO had no provision for this tactic nor did submarine crews have the doctrine or training to implement the order.²⁴ E.B. Potter summarizes the situation saying:

The US peacetime doctrine, anticipating attacks on warships only and overestimating the submarine's vulnerability, imposed excessive caution. The effect was aggravated by overcautiousness of some of the initial submarine skippers, men who had to be replaced by hotspurs ready and willing to take the risks that are a necessary part of submarine warfare.²⁵

Herwig identifies the root of this deficiency in the pre-war fleet training exercises. "The emphasis in tactical preparations remained on fleet operations; moreover, skippers who 'were caught during fleet exercises' more often than not received severe criticism from their superiors."²⁶ Naval leaders responded to the inadequate training problem by improvising a war patrol reporting, critiquing, and dissemination system. Admiral Thomas Withers, the commander of submarines in the Pacific, initiated this system the very first month of the war. It proved invaluable in sharing tactics each commander was

²⁴ Blair, 106.

²⁵ Potter, 333.

²⁶ Herwig, 259.

essentially making up as they went along in addition to their critical review of the results achieved. This system proved instrumental in eventually arriving at very effective tactics throughout the force.²⁷

Effective tactics alone were, however, insufficient; tactics must be tied to strategic objectives by sound operational planning. Once again, the Navy found itself lacking. DeRose writes, “Withers did not seem to have an overall strategy. There was no concentration of US boats against Japanese shipping choke points. Too many submarines were diverted to unproductive patrols in barren areas such as the Marshalls, even though the codebreakers knew that the Japanese had returned to empire waters.”²⁸ After forty years of planning and anticipation for war with Japan and twenty years of submarine experience, US employment of submarines in WW II essentially started with a blank piece of paper when the war came.

More startling than the dearth of operational or tactical theory and doctrine is the fact that US submarines put to sea on combat patrols with orders to conduct unrestricted submarine warfare armed with ineffective torpedoes. There were actually three separate problems with the US torpedo, the details of which are beyond the scope of this paper. The stark realization pertinent here is that the US Navy never tested the primary weapon of the submarine under anything but laboratory conditions with one very interesting exception. This exception involved an early version of the magnetic exploder, a design where the magnetic field of the ship’s hull triggers the warhead to explode. During this test, the first torpedo was fired from a test stand (firing from a submarine was considered too dangerous) but “ran deep,” passing the target vessel without exploding. As it turns

²⁷ James F. DeRose, *Unrestricted Warfare*, (New York: John Wiley & Sons, 2000), 37.

²⁸ DeRose, 38.

out, this failure demonstrated one of the three systemic problems the Bureau of Ordnance subsequently ignored despite incessant complaints and documented evidence from submarine skippers. The second torpedo exploded as expected, however, several important modifications to the exploder were incorporated in later versions yet were never tested under operational conditions.²⁹

In the end, we can trace submarine armament ineffectiveness to the fact that US Navy planners were unable or unwilling to think in terms of exploiting the characteristics of the subsurface medium. The conclusion that the submarine was an ineffective offensive weapon, tied inextricably to surface naval theory, yielded complacency in testing submarine armament. When complaints about malfunctioning torpedoes came in with the very first combat patrols, designers and senior leaders attributed the lack of success to poor crew performance, reflecting the bias established in pre-war fleet exercises, rather than technical deficiencies.³⁰ The torpedo problems were solved in mid-to late-1943 just as significant numbers of the newest US fleet submarines were becoming available. From this point on, the submarines were a menace the Japanese simply could not escape.

Potential Effects Not Realized

To be clear, this study argues that planning for employment of US submarines in WW II was non-existent; planning for the surface campaign was remarkably accurate and followed WPO guidelines quite closely.³¹ The question raised here is what might have been possible if the Navy started the war with the intent to exploit fully the subsurface

²⁹ Blair, 56 and 62.

³⁰ DeRose, 37-40.

³¹ Miller, 347.

medium. The technical capabilities necessary were available in the designs emerging from shipyards as the war began.³² WW I documented the submarine's potential with the first two years of WW II providing abundant reinforcement if considered objectively. The answer to our question is admittedly impossible to state with any degree of certainty, however the suggestion that events may have unfolded quite differently seems very plausible indeed, as illustrated by the following two examples.

Planners, designers, and operators would have almost certainly addressed the inadequacy of submarine armament in the form of ineffective torpedoes. An offensive mindset demands reliable weaponry; assessing weapon reliability demands realistic testing under operational conditions. Aggressive operational testing of the weapon would have facilitated identification and correction of the technical deficiencies in much the same manner it actually occurred during the war. Additionally, fielding of the submarine-captain preferred Mark 18 wakeless electric torpedo would have almost certainly occurred earlier for the same reason it happened in 1943: it protected submarine concealment and maximized offensive capability.³³ Reliable weaponry available at the outset of hostilities would have almost certainly changed the war's course of events by magnifying the effect achieved with the submarines available. Established tactics called for skippers to fire a "spread" of torpedoes, both to ensure a hit on a maneuvering vessel and to improve the odds of a detonation should more than one weapon reach the target. Improved accuracy gained through proficiency and weapons that were more reliable would have allowed fewer shots with greatly improved results. Each submarine would therefore be capable of attacking a greater number of targets on each patrol while sinking

³² Blair, 79-80.

³³ Derose, 224-5.

more of the targets it attacked. In other words, the effects achieved in the two-year period from late-1943 to August 1945 were conceivably achievable starting in December 1941. The author makes no predictions on what turn events might have taken in this scenario. Rather, the author makes the assertion that the effects this scenario envisions *would have* resulted in different strategic, operational, and tactical options for continued prosecution of the war.

Equally interesting to consider are the potential effects resulting from Japanese exploitation of the US vulnerability accepted in the assumption of a sanctuary in the eastern pacific. As will be explained further in Chapter 4, the Japanese objective was to wear down the US and negotiate a settlement ceding them control of the territory and associated natural resources they intended to seize around their home islands. Difficult as it may be to conceive today, it seems plausible to believe the Japanese had a legitimate chance to achieve their strategic objective. The Allied response to the U-boat in the Atlantic makes it quite certain a moderately successful Japanese effort to disrupt shipping between the US and its pacific forces would have diverted vast quantities of American resources, attention, and remaining naval strength. If the Japanese had executed this effort early in 1942 while their naval strength vastly outweighed US forces in the Pacific, three effects appear likely to have occurred. First, US costs in the Pacific would have skyrocketed. Second, US submarines would have likely been recalled to home waters to repel the Japanese. Third, the Japanese would have had a focus for their efforts following their successful campaigns of occupation other than to proceed with additional attacks outside their main objective area, thereby exacerbating their supply line vulnerability. Given any of these three effects and acknowledgement of the ongoing Battle of the

Atlantic raging in the Allied “Europe first” strategy, the potential for a different outcome in the Pacific seems significantly more plausible. This must necessarily be a tenuous conclusion as the ability to measure “resolve” is difficult even today, to say nothing of an environment where total war was the accepted norm. Nevertheless, the primary point of this section is to emphasize that different effects were available to both sides had they developed the theory to exploit the characteristics of the subsurface medium to its full potential. Attempting to understand why the Japanese never exploited this vulnerability is the subject of the next chapter.

Chapter 4

Imperial Japanese Navy Employment of Submarines in WW II

Tora, Tora, Tora! (Codewords for “complete surprise achieved”)

—Commander Mitsuo Fuchida, Imperial Japanese Navy
Pearl Harbor, 7 Dec 1941

An island nation long isolated from the rest of the world, Japan was utterly dependent on the ship-borne importation of raw materials to feed their burgeoning industrialization military expansion. On 26 July 1941, the day after the Japanese invaded French Indochina, the US, Great Britain and Dutch governments froze all Japanese assets and imposed a total petroleum embargo. John Prados described the Japanese situation as an hour-glass with the sand running, saying “One way or another, the crisis had to be resolved.”¹ Embracing war as the means to resolve their dilemma, this chapter focuses on understanding the Japanese approach to the exploitation of the subsurface medium in pursuit of their strategic objectives.

Japanese Naval Theory

The question under consideration in this section is whether existing Japanese naval surface warfare theory was capable of incorporating the relevant differences arising from

¹ John Prados, *Combined Fleet Decoded*, (New York: Random House, Inc., 1995), 110.

the emerging potential to exploit the subsurface medium. To accomplish this task, the section is divided into three parts including a discussion of existing theory and doctrine, submarine planning considerations, and Japanese vulnerability to US submarine attack.

Existing Naval Theory and Doctrine

The story of the rise and fall of the Japanese Imperial Navy is one filled with irony and missed opportunities. When, as Japanese Admiral Shigeru Fukudome relates, the 6 September 1941 Imperial Conference resolved to go to war with the US when necessary, they did so based on their need to acquire and import the raw materials British and American embargoes denied their nation.² Yet, the Naval General Staff (NGS) ignored protection of the shipping that transported these raw materials to Japan, as well as finished products to deployed forces.³ This disconnect is directly attributable to Japanese naval theory and its associated inability to understand and incorporate in their thinking the effects made possible by exploiting the subsurface medium. George Baer aptly summarizes Japanese naval theory as “more Mahanian than America’s.”⁴ This was not the Mahan who argued the defining purpose for armed shipping was to ensure the safe passage of merchant shipping, but rather that selected portion of Mahan prescribing a decisive fleet engagement as the most efficient means to ensure victory in time of war.

No better example of the primacy of this dogmatic application of Mahan exists than in the orders Admiral Yamamoto received as he prepared for conflict with the US. Fukudome, Yamamoto’s Chief of Staff, says the NGS entrusted Yamamoto with the

² Shigeru Fukudome, “The Hawaii Operation,” in *The Japanese Navy In WW II*, ed. and transl. Dr. David C. Evans, 2nd ed. (Annapolis, Md.: Naval Institute Press, 1986), 11.

³ David C. Evans and Mark R. Peattie, *Kaigun: Strategy, Tactics, and Technology in the Imperial Japanese Navy 1887-1941*, (Annapolis, Md.: Naval Institute Press, 1997), 431.

⁴ George Baer, *One Hundred Years of Sea Power: The US Navy, 1890-1990*, (Stanford, Calif.: Stanford University Press, 1994), 121.

“grave responsibility” to “accomplish the destruction of the US fleet.”⁵ Although the origin of the plan to attack the US fleet at Pearl Harbor is somewhat ambiguous, there is no doubt Yamamoto was its chief champion and architect at one point offering his resignation as Commander-in-Chief in protest of NGS proposed changes.⁶ Evans and Peattie argue convincingly that, “from the Russo-Japanese War onward, Japan never had a grand strategy. It possessed instead a set of perceived threats, nebulous ambitions, and a keen ability to exploit a strategic opening.”⁷ The strategy of the Navy therefore became Japan’s strategy and Admiral Yamamoto, as the Commander in Chief of the Combined Fleet, was responsible for naval strategy. Yamaoto’s objectives were never to defeat the United States, but rather to inflict high costs on the Americans and simply outlast their resolve leading to an inevitable negotiated settlement.⁸ Prados provides insight into Yamamoto’s thinking by quoting him directly from a January 1941 letter:

If it is necessary to fight, in the first six months to a year of war against the United States and England I will run wild. I will show you an uninterrupted succession of victories. But I must also tell you that if the war be prolonged for two or three years I have no confidence in our ultimate victory.⁹

Destroying the US fleet was not a requirement to achieve these objectives, however Yamamoto was convinced destruction at the outset was required to enable consolidation of the resource area; an intact US fleet would divert the Japanese navy’s attention during this all-important task.¹⁰ Though it emphasized the use of aircraft carriers rather than battleships, this was nonetheless a “decisive battle” from beginning to end. The Japanese

⁵ Fukudome, 7.

⁶ Prados, 110-117.

⁷ Evans and Peattie, 493-494.

⁸ Paul S. Dull, *A Battle History of The Imperial Japanese Navy (1941-1945)*, (Annapolis, Md.: Naval Institute Press, 1978), 7.

⁹ Yamamoto Isoroku as quoted by Prados, 127-128.

¹⁰ Prados, 128-129.

attack concentrated on suppressing US aircraft and attacking capital ships in the harbor; not touched in the assault were the fuel storage area containing more than four and a half million gallons of fuel oil and aviation gasoline, the harbor maintenance facilities, and the nine submarines tied up at their piers.¹¹ The loss of the fuel and facilities would almost certainly have rendered Pearl Harbor inoperative and required the withdrawal of whatever fleet units remained to the western coast of the US.¹² The difficulties and additional expenses this eventuality would have imposed are incalculable but indisputably immense, as would have been their effect on the war itself.

Submarine Planning Considerations

In contrast to American planning for employment of submarines in support of fleet operations, the Japanese trained and exercised their submarines in several specific missions within the framework of their war plan as they pursued the decisive battle their theory demanded. However, the tactics developed by the general staff and obediently followed by submarine commanders were fundamentally flawed and prevented mission accomplishment, a fact the Japanese were aware of yet failed to address.¹³ “Japanese submarines, in accordance with the principle of interceptive operations, were intended to lie in wait for the enemy battle fleet, shadow it, and attack it with torpedoes.”¹⁴ Implicit in these tactics is the ability first to *locate* the opposing fleet, a capability the Japanese sorely lacked. Their solution was to occupy a position on a likely route and wait for the enemy fleet to appear – just as surface naval theory would recommend. American

¹¹ Dull, 19.

¹² Samuel Eliot Morison, *History of United States Naval Operations in World War II*, Vol. III, *The Rising Sun in the Pacific, 1931-April 1942*, (Boston: Little, Brown, 1948), 132.

¹³ Evans and Peattie, 432 and 434.

¹⁴ Ronald H. Spector, *Eagle Against the Sun: The American War with Japan*, (New York: Random House, Inc., 1985), 48.

submarines employed similar tactics with one essential difference: the US subs were *initiating* contact by virtue of exploiting intelligence on Japanese ship movements. Having located a Japanese vessel, US submarines would maneuver to intercept and complete their attack. Japanese tactics voluntarily ceded the initiative offered by exploitation of concealment in the subsurface medium to the adversary: if the adversary failed to present himself for attack, the Japanese submarines went home without firing a shot.

The Japanese attack on Pearl Harbor was also their only well-organized use of submarines in a coordinated fleet action. Twenty Japanese submarines ringed the mouth of Pearl Harbor lying in wait for any ships attempting to escape the air raid as well as being in place to alert the fleet should the US fleet sortie in an attempt to chase the retreating Japanese surface vessels.¹⁵ This mission assignment followed Japanese submarine doctrine closely. Evans and Peattie describe this doctrine as follows:

The missions assigned to [the Japanese submarine force] were the extended surveillance of the enemy battle fleet in harbor, the pursuit and shadowing of that fleet when it sortied from its base, and the ambushing of the enemy by pursuing submarines that would destroy a number of his capital ships and thus reduce his battle line just before the decisive surface encounter with the Japanese battle fleet.¹⁶

In the minds of Japanese naval leaders, the results they achieved at Pearl Harbor did not warrant the effort expended. This affected submarine employment for the remainder of the war by convincing naval leaders the submarine was an inept offensive weapon.¹⁷

The Japanese understood and planned to exploit the essential characteristic of the subsurface medium, but dogmatically applied this new capability to their existing surface

¹⁵ Clay Blair, *Silent Victory: The US Submarine War Against Japan*, (New York: J.B. Lippincott Company, 1975), 86.

¹⁶ Evans and Peattie, 428.

doctrine of decisive engagement. Evans and Peattie conclude, “Despite the [Japanese] navy’s intensive training and development of new tactics, by the eve of the Pacific War, the navy had apparently not resolved the central problem of submarine tactics: the opposing requirements of self-preservation and aggressiveness.”¹⁸ The failure to achieve results rendered the submarine an ineffective weapon in the eyes of senior naval leaders, thereby leaving them with no mission they were capable of completing. This led directly to the use of Japanese submarines in roles they were completely ill-suited to perform. “Beginning in the summer of 1942, plans were drawn up for an unrestricted submarine campaign along the lines of the German U-boat effort; but by the autumn of 1942, Japanese submarines that might have been employed against US shipping were being diverted in large numbers to carrying supplies for beleaguered Japanese garrisons in the Pacific.”¹⁹

Japanese Vulnerability to US Submarines

“On a theoretical level, the Japanese navy acknowledged the problems of protecting Japan’s merchant shipping, but it failed to undertake any concrete measures that would make such protection effective.”²⁰ In respect to antisubmarine warfare (ASW), the Japanese were at a distinct disadvantage for not having obtained the extensive experience of the other major combatants during WW I. What experience was gained by the handful of destroyers sent to augment British forces in the Atlantic made little impression on the NGS.²¹ Atsushi Oi, a member of the NGS responsible for coordinating shipping in support of the Navy, explains that even deeper seated than the lack of experience in

¹⁷ Prados, 196.

¹⁸ Evans and Peattie, 433.

¹⁹ Spector, 486.

conducting these types of operations was the lack of a basic appreciation for the importance of the mission.²² After all, as was shown earlier, Japanese doctrine called for employment of submarines in support of the battle fleet; the Japanese assumption that American submarines would be employed in a similar manner, while accurate up to 7 Dec 41, created a fatal blind spot in Japanese planning. “The Japanese could not envision the possible consequences of a concerted and massive underwater offensive by American submarines against Japanese commerce and supply lines.”²³

Illustrating again the pervasiveness of the surface warfare theory is the fact that no single military command or force received the mission to protect Japanese commerce until April 1942, and then it was only a handful of old destroyers and decrepit gunboats.²⁴ The Combined Fleet laid claim, as was their habit up to the very end of the war, to all the newest destroyers and frigates as it attempted to assemble the great fleet battle that would ensure a decisive victory. At the same time, due largely to the Empire’s success in accomplishing their objectives in the early stages of the war, Japanese forces were extending their lines beyond the original defensive perimeter, thereby exposing their shipping to even greater danger. Atsushi Oi describes how these competing interests came to a head in September 1943 when the military requested an additional 300,000 gross tons of shipping be transferred from civilian to military control and that aircraft production be increased to 55,000 per year. Already 300,000 gross tons under the minimum necessary to sustain the civilian war effort, the government balked at the

²⁰ Evans and Peattie, 435.

²¹ Evans and Peattie, 435.

²² Atsushi Oi, “Why Japan’s Antisubmarine Warfare Failed,” in *The Japanese Navy In WW II*, ed. and transl. Dr. David C. Evans, 2nd ed. (Annapolis, Md.: Naval Institute Press, 1986), 386.

²³ Evans and Peattie, 218.

²⁴ Spector, 486.

request. In the end, the sides reached a compromise agreement neither side had the capability or intention to abide by and therefore accomplished nothing.²⁵

In summary, the Japanese navy went to great lengths to integrate the submarine into their existing surface naval theory to include extensive planning and fleet exercises. In the end, this system failed quite miserably. Having pursued integration with single-minded fervor and achieving meager results, the Japanese NGS relegated the majority of their submarines to cargo ships, never recognizing the large blind spot that existed in both their offensive and defensive strategies for exploiting the subsurface medium.

Section II: Contextual Influences

Second only to Great Britain, the Japanese had extensive and extremely successful experience implementing their decisive battle naval theory, not the least of which was the 1905 victory over Russia in the Battle of Tsushima Straits. This victory was, in fact, the impetus that established Japan as one of the world's foremost naval powers and earned them a seat at the table during the Washington Naval Conference.²⁶ As their doctrine and experience would suggest, the Japanese delegation focused almost exclusively on capital ship restrictions while being essentially ambivalent about prohibitions on unrestricted submarine warfare. Faced with the threat of a naval arms race their economy simply could not support and recognizing they were falling behind the US in gross tonnage, the Japanese were willing to accept the indignity of being labeled a "lesser power" to achieve restrictions on the growth of the US fleet.²⁷ This willingness decreased as Japanese naval power increased until, by 1930, nothing less than 10:7 was acceptable and, by 1935, it

²⁵ Atsushi Oi, 399.

²⁶ John Keegan, *The Price of Admiralty*, (New York: Penguin Books, 1988), 192.

²⁷ Prados, 12.

was parity or nothing.²⁸ The salient point to take from this discussion is the Japanese drive to emerge, in terms of Mahanian capital ships, as the equal of any other world maritime power.

The drive for parity in world maritime circles has a large, if indefinite, cultural component. Atsushi Oi mused, “Maybe, at the bottom of our naval tradition, there was problem of racial temperament. Compared with the Europeans, the Japanese are generally said to be more impetuous and less tenacious.”²⁹ This explanation is wholly without merit, as any veteran of Iwo Jima or any number of ground, sea, or air battles in the Pacific will attest. It is also inconsistent with the overriding responsibility of the Japanese armed forces to protect the emperor and the homeland. The answer is rooted in the human species, but is more fundamental than Atsushi supposes. The simple fact is the Japanese government consisted of at least three distinct factions (the army, navy, and civilians) all in a fierce competition for power and authority, with only the emperor above them all.³⁰ Lacking a unified strategic vision, each faction pursued their own vision believing it superior to all others with their conduct reflecting their beliefs. For the Imperial Navy, the result was the self-reinforcing conviction of the need and desire for a decisive fleet battle; everything else was subordinated to this overwhelming drive.

Section III: Operational Impacts Resulting from Decision

The Japanese failure to understand the potential effects achievable through exploitation of the subsurface medium, by virtue of their fixation on surface naval theory, was a primary contributor to their defeat. The question of whether Japan’s defeat was

²⁸ Baer, 117.

²⁹ Atsushi Oi, 387.

³⁰ Evans and Peattie, Fig 1-3, 27.

inevitable in the face of the undivided attention of the US following the conclusion of the European war is often answered unequivocally in the affirmative without real care being given to understanding what effects might have been possible given a radically different progression of events. As we did in the US case, we will first examine the observable effects resulting from the decision to integrate exploitation of the surface and subsurface media, then turn to those potential effects that were plausibly possible but never realized.

Effects Observed

The Japanese committed what is perhaps one of the worst examples on record of what we have come to call “mirror imaging.” As Atsushi Oi makes clear, “The Japanese navy took it for granted that the role to be played by American submarines would be the same as that of Japan’s own submarine forces and slighted their role as raiders of commercial shipping. Those were probably the primary reasons why the Japanese navy neglected preparations for ASW.”³¹ The Japanese navy, to an extent difficult to understand today, was blind to the potential of the subsurface medium except as it supported their concept of surface warfare. As their interception strategy required careful positioning of submarines in the path of oncoming US fleet units, the Japanese implemented a system to control deployed submarines with shore-based units, routinely requiring frequent, two-way communications.³² The fact that, in the attempt to exploit the concealment of the submarine, they were exposing it to relatively precise location through communications intercepts and direction finding techniques completely escaped the Japanese. As Blair relates, “[Japanese submarines] were ordered about by the Japanese submarine commanders, with specific departure and arrival dates, speed of

³¹ Oi, 388.

advance, tracks, and ‘noon positions’ to be adhered to.”³³ Directing attacks against these submarines or rerouting ships around them became second nature for US intelligence. In the end, the Japanese navy operated one hundred eighty-seven submarines over the course of the war; their impact on the outcome was negligible at best. “In its primary mission, the Japanese submarine fleet failed to turn the course of the naval war: not one single major naval engagement in the Pacific was significantly affected by Japanese submarines.”³⁴

The inability of the Japanese to conceive of an effective offensive mission for the submarine directly contributed to their inability to recognize their tremendous vulnerability to unrestricted submarine warfare. The illustration of this contention in the ineffective and unenthusiastic manner the Japanese conducted ASW was examined above and requires no further elaboration here. The effect of this missed opportunity was, as Atsushi Oi confirms, to give the Americans the opportunity to perfect their tactics and solve their torpedo problems such that, starting in the fall of 1943, Japanese commerce was put in an inescapable stranglehold.³⁵

Potential Effects Not Realized

It is quite probably too much to ask that the Japanese navy would have recognized their vulnerability to commerce raiding and built an adequate ASW capability in response. The momentum in favor of capital ships coupled with limited resources required tough choices and the “unproven” capabilities of the submarine were simply not strong enough to overcome the “proven” theory of decisive fleet battles. Conversely, the

³² Evans and Peattie, 430.

³³ Blair, 117.

³⁴ Evans and Peattie, 497.

Japanese stood well above other nations in recognizing the potential and repeatedly achieving surprise over their adversaries. They did recognize the potential to achieve tactical surprise by exploiting the concealment of the subsurface medium but failed to create the tactics and organizational structures necessary to realize the potential. As hostilities commenced, their submarines were more than adequate and, equipped with probably the best torpedoes in the world, were capable of inflicting significant costs on US shipping.

This idea was in fact proposed in great detail to the NGS by Vice Admiral Inoue Shigeyoshi in a memorandum titled “On Modern Weapons Procurement Planning.”³⁶

Spector writes:

[Inoue] urged the navy to junk its plans for ‘the decisive battle,’ and prepare instead for protracted air- and amphibious warfare in the central Pacific, use its submarines to attack enemy commerce, and build larger numbers of escort vessels to keep its own lines of communications open. These ideas made no impression on the Naval General Staff.³⁷

Recognizing the intention of this strategy was to inflict unacceptable costs rather than achieve a military victory, Evans and Peattie suggest two possible effects. The first was the complication of American planning in overcoming the distances involved in operating between the eastern and western pacific, especially if the US outposts at Guam and Midway fell as planned. The second was the psychological shock to American morale facing commerce raiding on both coasts.³⁸ Both of these outcomes directly supported

³⁵ Atsushi Oi, 396-397.

³⁶ Evans and Peattie, 483.

³⁷ Spector, 48.

³⁸ Evans and Peattie, 218.

Japanese strategic objectives, yet the NGS never considered the plan in anything approaching objectivity.

Chapter 5

The Air and Space Media

Whereas those who have the capability to control the air, control the land and sea beneath it, so in the future it is likely that those who have the capability to control space will likewise control the earth's surface.

— Gen Thomas D. White
Chief of Staff, USAF, 1957

The goal of our military force is to accomplish the objectives directed by the National Command Authorities. For the joint force of the future, this goal will be achieved through full spectrum dominance.

—Joint Vision 2020

The goal of the US military in fighting war is to accomplish the objectives set forth by the National Command Authorities (NCA). The USAF assertion, echoing Clausewitz, that “war is an instrument of national policy” is the fundamental theory of war on which airpower theory is based.¹ Space is becoming increasingly important in support of national policy, but not solely as an arena for the support or conduct of military affairs. The most recent national security strategy (NSS) asserts “... the protection of our critical infrastructures – including energy, banking and finance, [and] telecommunications ...” are vital interests of the United States.² As space systems are intimately intertwined in each of the four areas enumerated above “to an extent not understood by most

¹ Air Force Doctrine Document 1 (AFDD-1), *Air Force Basic Doctrine*, September 1997, 6.

² William J. Clinton, *A Security Strategy for a New Millenium*, (Washington, D.C.: Government Printing Office, 1999), 1.

Americans,” according to retired USAF General Howell Estes, protection of the nation’s space systems is functionally equivalent to the protection of the nation’s borders.³

While Gen Estes’ comments reflect the growing importance of space systems to national infrastructure, “protection” is but one mission assigned to military services. In fact, the USAF is tasked with exploiting “...the full range of air and space capabilities to accomplish the missions assigned by National Command Authorities (NCA).”⁴ For military professionals then, the challenge is to exploit the attributes of all media, necessarily including the space medium, to the maximum extent possible in support of NCA objectives. The question we must answer is whether aerospace theory or separate air and space theory best enables us to exploit the warfighting potential the space medium offers.

However, before beginning an examination of the media we must briefly return and answer the question as to whether or not air and space are in fact distinct media. If the USAF is reluctant to acknowledge space as a distinct medium, the DoD is not. The DoD Space Policy says explicitly, “Space is a medium like the land, sea, and air within which military activities shall be conducted to achieve US national security and economic well-being.”⁵ As will be shown, the defining element of the air medium is a sufficient quantity of air molecules to allow the body in motion (i.e. an air vehicle) to act on these molecules and achieve the dynamics of flight. The defining element of the space medium is the lack of these very same molecules and the dominance of Koepler’s Laws of Interplanetary Motion. Arguing that, because a distinct precipice where one falls from air into space

³ Howell M. Estes, III, in the “Forward” to Jim Oberg, *Space Power Theory*, (Colorado Springs, Colo.: USAF Academy, 1999), ix.

⁴ AFDD 1, v.

⁵ DOD Directive 3100.10, *Space Policy*, 9 July 1999.

does not exist and therefore a boundary does not exist is disingenuous. Media are defined by attributes that are either present or not. How these attributes affect the ability to operate in a specific medium becomes the distinguishing characteristics of the medium. The boundary between air and space is *invisible* to the human eye, but it absolutely does exist.

The Physical Attributes of the Media

Even before Orville Wright left the ground for his twelve-second flight in 1903, exploiting the air medium in warfare was the subject of much heated debate among war's practitioners as well as "fantasy" writers such as H.G. Wells and Jules Verne.⁶ Michael S. Sherry asserts, however, in his award winning book *The Rise of American Airpower*, "Aside from technological advances, what encouraged some military men to assign a more ambitious role to airplanes remains unclear. The few strategists who articulated such a role rarely indicated the source of their ideas."⁷ This study endeavors to avert this mistake by clearly defining what is it about the air and space media that make them different from other media.

The Physical Attributes of the Air

At the risk of stating the obvious, it is clear the primary physical difference between the air and most other media is in the way it enables man to act in the vertical, or third, dimension. This study contends this basic difference between air and surface media serves as the basis for all subsequent air theory. Before supporting that assertion,

⁶ Phillip S. Meilinger in the "Introduction" to *The Paths of Heaven: The Evolution of Airpower Theory*, ed. Colonel Phillip S. Meilinger (Maxwell AFB, Ala.: Air University Press, 1997), xii.

⁷ Michael S. Sherry, *The Rise of American Airpower: The Creation of Armageddon* (New Haven, Conn.: Yale University Press, 1987), 12.

however, it is useful to examine the critical element that enables this capability: the atmosphere of the earth. Brigadier General William “Billy” Mitchell described the atmosphere as “...the most vast, the most important, and the farthest reaching element of the earth....”⁸ While a technical discussion of computational fluid dynamics is well beyond the scope of this paper, recognition that there are laws governing the motion of a body through gas (e.g. air) is necessary and, thankfully, sufficient. Even though air is invisible, it must be *acted on* in accordance with these laws in order to exploit the vertical dimension, just as a tire (or a boot, for that matter) requires contact with a hard surface for traction or a ship’s propeller must have water against which to exert force. This is true even for a system such as the Army’s Multiple Launch Rocket System (MLRS). The shape of the rocket body must act on the atmosphere to carefully manage aerodynamic forces and achieve stable flight through the medium. In each case, movement within the medium requires an action to overcome the force of the earth’s gravity. The other obvious but important property of air is its total envelopment of the planet’s surface, or in other words, the lack of physical boundaries. It goes without saying this is not true of any single surface medium, thereby giving airpower access to the entire surface of the planet. Taken together, these two properties proved an intoxicating mix for airpower theorists.

The Space Medium

It is important to note that this study focuses on systems designed with a terrestrial focus, as opposed to systems designed to operate extra-terrestrially. The reason for this focus springs from the “national security” aspect of military affairs. Given the earlier

⁸ William Mitchell, *Winged Defense* (Mineola, N.Y.: Dover Publications, Inc., 1988; originally published

quoted statement that war is an extension of politics and the understanding that politics are the province of mankind, we recognize our goal in conducting military affairs is to affect human beings. As man's natural environment is the land, military affairs, in its most general sense, envisions affecting events on land, regardless of the medium in which we conduct military activities. A less encompassing but still important secondary reason is the allocation of responsibilities in the National Space Policy. The National Aeronautics and Space Administration (NASA) is assigned responsibility for extra-terrestrial space systems; the Department of Defense is not.⁹

Before analyzing the space medium, it is necessary to define what the term "space medium" means. Volume II of the *Space Handbook* discusses this subject at length, illustrating just how varied the definitions of space are depending on the context of the question. As we are concerned with distinguishing space from air, we will use the definition of astronautical engineers, namely that space begins at approximately sixty-two miles above the surface of the earth, the point at which aerodynamic forces resulting from the earth's atmosphere become negligible.¹⁰ Recognizing that everything beyond "sixty-two miles above the surface of the earth" is a mind-numbing quantity of "space," establishing an outer boundary is also necessary. Recalling the focus of the study is on the ability to affect terrestrial events, we define the outer limit of "space" for purposes of this study as the highest altitude at which a body remains in earth orbit. Keeping this definition in mind, one can immediately grasp the key physical attributes of space.

in Toronto by General Publishing Company, Ltd., 1925), 3.

⁹ The White House, *National Space Policy Fact Sheet*, (Washington D.C.: GPO, 1996), 2-5.

¹⁰ Michael J. Muolo, *Space Handbook: An Analyst's Guide* (Vol II; Maxwell AFB, Ala.: Air University Press, 1993), 3-5.

The Physical Attributes of Space

Again, at risk of stating the obvious, space also uses the vertical dimension with the essential difference between space and other media being the fact that space is a vacuum; that is, there is no atmosphere, no earth, and no sea. The result of this vacuum is that a body in space is at the mercy of interplanetary forces, primarily composed of the earth's gravity at orbital altitudes of interest to this study. The only means to overcome the effect of gravity in space is speed. Oberg describes it as "falling over the horizon." "If you have the proper forward speed, the surface [of the earth] recedes at the same rate as you fall towards it."¹¹ Because of the vacuum in space, a tension exists between the speed of the body and the force of gravity. The orbit of a space vehicle is determined at the point where this tension comes to equilibrium. The speed required to reach equilibrium is proportional to the altitude of the orbit; that is, the higher the orbital altitude desired, the greater the speed required to attain it. This leads to perhaps the most counter-intuitive aspect of space operations: to speed up (i.e. reduce the time required to circle the earth), you must slow down (i.e. operate closer to the earth, and therefore at a slower orbital speed). This statement also highlights the potential confusion over the word "speed," an issue addressed in greater detail below.

The result is that the laws governing operation in the medium require a body to operate at a certain speed thereby confining it to a very specific orbital path comprising a miniscule portion of the enormous space medium. The freedom of movement within the orbit, and therefore within the entire space medium, approaches zero. The external boost vehicle lifting a satellite into orbit provides the speed, often referred to as "energy" for reasons discussed below, required to achieve equilibrium in the initial orbit. Any

maneuver beyond the most minor adjustments require tremendous amounts of energy (called *delta v* for change in velocity), energy that few space vehicles can generate. Future advances in energy generation and propulsion efficiency are likely and may enable greater maneuverability, nevertheless the inescapable fact is that the laws of interplanetary motion – of orbits – will still apply and govern this increased maneuverability. If a space system does maneuver, it is maneuvering into a new orbit that, once achieved, imposes the same lack of maneuverability. Planners designing a satellite system *position* satellites in orbits in order to achieve the earth coverage desired. The NAVSTAR Global Positioning System (GPS) is a perfect example. This constellation is composed of twenty-four satellites in six orbital planes, with four satellites per plane. Each of the satellites is moving at many thousands of miles per hour, and yet, each must maintain its orbital position relative to its neighbors in order for the constellation to function as designed.

Section II: Shaping Warfighting Theory

The Air Medium

To exploit the air medium, an air vehicle must achieve the dynamics of flight. The dynamics of flight offered man the potential to operate free of the restrictions of the surface, which, by virtue of the physical characteristics of the air medium, required the air vehicle to operate relatively faster and enabled it to travel relatively farther than surface units. The speed, range, and freedom of maneuver themes permeate literally all of airpower theory. Douhet, as previously quoted, specifically identified speed and freedom of maneuver as the two key benefits of the air medium. Mitchell said, “as the air

¹¹ Jim Oberg, *Space Power Theory*, (Colorado Springs, Colo.: USAF Academy, 1999), 24.

covers the whole world, aircraft are able to go anywhere on the planet.... In a trice, aircraft have set aside all ideas of frontiers. The whole country now becomes the frontier and, in case of war, one place is just as exposed as another place.”¹² Colonel John Warden describes the enemy as a system composed of rings with outer rings protecting the innermost rings; he asserts that only forces operating in the air medium are capable of bypassing the outer rings to attack directly the more important inner rings.¹³ Phillip Meilinger says in his second proposition about airpower, “To a great extent airplanes obviate the need to confront terrain or the environment because of their ability to fly over armies, fleets and geographic obstacles and strike directly at a country’s key centers.”¹⁴

The Space Medium

Space offers the opportunity to exploit the vertical dimension—often colloquially called “the ultimate high ground.” This term contains more insight than might, at first, be obvious: “high ground” to a soldier is a terrain feature, a position of advantage. Space is, by definition, high above the surface of the earth, but the physical characteristics of the medium requiring a vehicle to follow a prescribed orbit also make it positional in nature. Given information describing the orbit (called an “orbital element set”), we can predict with precision exactly where in the orbit the vehicle is located.¹⁵ By altering the orbital element set appropriately, a satellite is capable of tracing a ground track over any location on the earth.¹⁶ It is this position-dominant quality of space, or vantage point, that holds potential for exploitation in support of military activities.

¹² Mitchell, 4.

¹³ Col John A. Warden III, USAF, “The Enemy as a System,” *Airpower Journal* 9 (Spring 1995): 40-55.

¹⁴ Meilinger, *10 Propositions About Airpower*, 11.

¹⁵ Muolo, 59.

¹⁶ Muolo, 60-65.

Space exploitation is not, however, as “simple” as putting a vehicle on orbit. An airplane requires extensive support before takeoff, but once in the air is capable of achieving effects independent of any support infrastructure. Exploiting the space medium requires similar infrastructure to put the vehicle on orbit, but additionally requires a network including the space segment, a ground segment, and the communications to connect the two called the “link” segment before any effects are achievable. The requirement for this network arises, again, from our focus on affecting terrestrial events; the “mission data” a satellite obtains is of no value unless it gets to a human who can make use of it. In theory, placing a man in the space vehicle reduces the reliance, but it does not eliminate the need for the network. In current practice, any observer of a space shuttle launch and subsequent mission would certainly gape open-mouthed at the idea of reduced reliance on ground systems and the links connecting the two.

Differences in the Air and Space Media

The first difference, alluded too earlier, is the concept of speed: in the air, speed refers to the rate at which an air vehicle traverses the surface of the earth. In space, the speed of the vehicle determines the orbital altitude at which the vehicle operates. Only through extrapolation does this correspond to a rate at which the vehicle traverses the earth’s surface.

The product of speed and time is distance, or range. Again relative to surface vehicles, the range of an air vehicle is orders of magnitude greater. However, range is a concept completely foreign to space systems. Air vehicles fly a mission lasting, at best, hours. The mission lifespan of space systems is typically years.

An air vehicle having achieved the dynamics of flight, is free to maneuver anywhere within the three-dimensional “envelope” defined by the air vehicle’s operating performance. As has already been addressed, the maneuverability of an on-orbit space system approaches zero in operating within a very small portion of the overall space environment. The only constraint on the air vehicle’s freedom of maneuver is self-imposed, as in the case of respect for national borders. Of course, borders do not physically exist in the air, however, international acceptance of the requirement to respect borders have created a de facto border in the air.

The fact that nations consider the air above their territory part of their sovereign state while space, in accordance with international treaty, recognizes no national borders and is available to all nations illustrates another difference explicitly.¹⁷ Realistically, this is recognition of physical laws as there is no way to operate in space without crossing the borders of other nations. The only exception would be a nation located on the equator with a geostationary satellite positioned above its territory. Even then however, the various perturbations present in space would cause the satellite to drift and trace a ground path on the earth that might very well cross the borders of adjacent states. Moreover, no space vehicle can launch and ascend directly to geosynchronous orbit. It must first traverse a series of transitional orbits that take it across international borders enroute to its final orbital position.

Taken together, the speed, range, and freedom of maneuver of a given air vehicle yields a tremendously flexible tool for use in military activities. Individual space vehicles, in contrast, are very inflexible. A space vehicle’s mission parameters are

determined during ground construction; once on orbit, the performance of the vehicle within these parameters will only degrade as components fail. It is certainly plausible that we may be able to use the data from a satellite more efficiently or effectively or in different applications, but the data itself does not change. The fixed nature of the ground segment of space systems also restrains flexibility.

The requirement to operate a space system as a network, coupled with position-dominance, is also exploitable, as any number of satellite systems demonstrate.¹⁸ Perhaps the most discussed exploitation potential is for around-the-clock, or “staring,” observation of the earth’s surface: the “holy grail” of intelligence collection.¹⁹ The potential to perform a mission similar to this from the air medium, while theoretically feasible, would be astronomically complex, to say nothing of expense.

Perhaps the least obvious difference between the two media is the frame of reference used to locate vehicles operating in either media. An air vehicle is located by identifying its position in relation to a point on or above the surface of the earth, typically related in terms of latitude and longitude. The locating system for the space medium uses the center of the earth as the origin and the celestial sphere (“a non-rotating sphere with infinite radius”) as a reference frame.²⁰ Again thankfully, there is no need to fully understand these complex concepts for the purpose of this study; it is enough to recognize that the frames of reference are very different.

¹⁷ Treaty on Principles Governing the Activities of States in the Exploration and Use of Outer Space, Including the Moon and Other Celestial Bodies (1967), Article I, available online at: <http://www.asi.org/adb/03/05/outer-space-treaty.html>.

¹⁸ For example, the GPS, Milstar, Defense Satellite Communication System, and Defense Support Program provide, to one degree or another, virtually complete global coverage through a network of satellites and ground stations.

¹⁹ Barry D. Watts, *The Military Use of Space: A Diagnostic Assessment*, (Washington D.C.: Center for Strategic and Budgetary Assessments, 2001), 82.

²⁰ Muolo, 57.

Relevance to Existing Theory

Having established a basis for understanding the attributes of the media in question and how these attributes shape warfighting theory, we are now prepared to consider the relevancy of the differences in the two media. Our task in the final section of this chapter is to answer the question, “Were differences in the attributes of the second medium relevant to existing theory?”

We have established that air theory is based on exploiting the unequal flexibility of aerodynamic vehicles operating in the air medium. This flexibility results from the combination of speed, range, and freedom of maneuver. In examining the space medium, we determined the key physical characteristic was its position-dominance determined by the inflexible nature of orbital mechanics. As we identified in the naval subsurface case, the differences in the media fall into the broad categorization of mobility – that is, how a vehicle moves within the medium. Environments with different physical attributes enable different capabilities that, in turn, enable different strategies and tactics. Speed, range, freedom of maneuver, flexibility, and borders are concepts with entirely different meanings when considering the attributes of the air and space media. On top of these differences is the realization that we must *think* from a completely different frame of reference to understand movement in the media. The conclusion is inescapable: the physical differences in the space medium are entirely relevant to existent air theory.

Technology and The Future. An alternative argument frequently heard is that technology will one-day be capable of overcoming the differences between the two media thereby returning it to “one indivisible whole” envisioned by General Larry D. White, the man credited with coining the term “aerospace,” in 1954. Two NASA programs

attempted to implement the vision of a single platform capable of operations in both media. DoD also has a concept envisioned to leverage the technology developed in the now-terminated NASA programs, however, Congress has not funded the military space plane.²¹ The argument in favor of such “multi-media” vehicles fails to address the fundamental fact that the environments are different – regardless of the technology – and therefore leaves the question asked in this study unanswered. Major Bruce M. DeBlois emphasizes this point in saying “...five hundred years of western experience...” teaches us operations in each media are complex, requiring the expertise of professionals trained to exploit the advantages the media have to offer.²² In the end, Jim Oberg provides an insightful comment on the differences between the air and space media: “Space really IS ‘unearthly.’ It’s not LIKE our earthside (*sic*) environment... This implies that while it’s true that space is a physical frontier, it’s also a mental one.” (emphasis in original)²³ The discussion in this chapter substantiates this assertion.

Section IV: Accommodation or Creation: A Question of Theory

Benjamin S. Lambeth, in *The Transformation of American Air Power*, says, “A functional or operational, as opposed to a systems, approach to thinking about space power application should make the differences between orbital and atmospheric operations irrelevant.”²⁴ This is essentially the same argument, or justification, the USAF

²¹ Both NASA programs were recently terminated while the DoD program remains unfunded. See David Leonard, “NASA Shuts Down X-33, X-34 Programs,” 1 March 2001, available online at: http://www.space.com/missionlaunches/missions/x33_cancel_010301.html

²² Bruce M. DeBlois, “Ascendant Realms: Characteristics of Airpower and Space Power,” in *The Paths of Heaven: The Evolution of Airpower Theory*, ed. Phillip S. Meilinger (Maxwell AFB, Ala.: Air University Press, 1997), 565.

²³ Oberg, 3.

²⁴ Benjamin S. Lambeth, *The Transformation of American Air Power*, (Ithaca, N.Y.: Cornell University Press, 2000), 258.

cites in pursuing the exploitation of “aerospace” in terms of a “seamless operational medium.”²⁵ Lambeth and the USAF argue that operational effects are what matter, not environmental differences. This thesis argues environmental differences *determine* what operational effects are possible, and therefore must be the basis for understanding the exploitation potential of space. Although neither Lambeth nor the Air Force explicitly state that airpower theory and doctrine are sufficient for the exploitation of space, the effect of the admonition to treat the two media as an “indivisible operational medium” is to make just that claim.

Not provided in this directive is guidance on how to extract the lessons of history and experience or organize ideas as they relate to the space medium. The advent of stealth technology will suffice as a brief example. Through the lens of airpower theory and doctrine, stealth technology increases an air vehicle’s freedom of maneuver (by granting it greater access to denied areas) – a very desirable quality. Through the lens of hypothetical spacepower theory and doctrine, the ability to mask a vehicle’s position may or may not have value. The nature of the physical principles governing the space medium means that orbital paths are highly predictable, therefore a satellite’s position is quite easily determined without ever observing the vehicle on orbit directly. On the other hand, the US has areas we wish to deny to adversaries. A “stealthy” air vehicle still emits an infrared signature and disturbs the atmosphere through which it passes – both are detectable phenomena from space, presuming the space vehicles are in the correct position and are “looking.” The ability to exploit the space medium to defeat stealth technology generates completely different effects than using stealth technology to exploit

²⁵ United States Air Force, *The Aerospace Force* (Washington D.C., 2000), i. See also, United States Air Force, *America’s Air Force Vision 2020: Global Vigilance, Reach, and Power*, (Washington D.C., 2000),

the air medium. The point is the physical characteristics of the medium determine the potential capabilities possible from full exploitation of the medium. We must view history, experience, and ideas through the lens of an exploitation theory appropriate to the medium if we are to realize the full potential of the medium.

Finally are the implications of an integrated aerospace theory and doctrine on the other military services and instruments of national power. Again, ground and naval warfighters look at history and experience through a different lens than do airmen, to say nothing of diplomats or economists. What potential capabilities does exploiting space offer these organizations *without reference to airpower*? The author makes no claim to have the answers, but confidently asserts these capabilities, and hence effects, will emerge if we but make the effort to understand the space medium.

Contextual Influences

There is room for at least several full-blown thesis topics within the broad category of “contextual influences” affecting this debate, however, the issue the author believes is having the greatest impact is the lack of a national vision for space exploitation. Answering the question, “Who is responsible for military activities in the sea medium?” is the type of test question students live to answer. Conversely, answering the question, “Who is responsible for military activities in the space medium?” is the type of essay question students’ dread. The answer to “Who is in charge?” is nobody. Brigadier General Simon “Pete” Worden wrote in a recent issue of *Aerospace Power Journal* that, “the Air Force does not have an assigned responsibility to be the ‘steward’ for space, and

Air Force leadership has been quite reasonable in its approach to the situation.”²⁶ While true as far as it goes, one wonders whether this statement is voicing the position that the Air Force is only responsible for space as it applies to airpower.

In any event, the fact is that a national vision for exploiting the space medium does not exist. Lieutenant Colonel Peter Hays and Dr Karl Mueller, both of the faculty of the School of Advanced Airpower Studies (SAAS), recently collaborated to review the USAF’s aerospace integration effort with this final, and perhaps most important, recommendation: “...we reiterate the importance of focusing on the first-order issue of developing a robust and comprehensive vision for United States space power rather than becoming mired in premature debates over the second-order issue of how to organize the management of national security space.”²⁷ The bottom line within the US government, as with all bureaucracies, is the allocation of resources. Resources will almost always be limited. Lacking a clear vision and associated division of national resources, the USAF confronts a very difficult task attempting to balance the requirements of supplying the nation with both airpower and space power. It seems quite plausible the “aerospace” philosophy is the USAF’s best effort to achieve this balance. This author believes we can, and must, do better.

Operational Impacts

Theory and doctrine guide operators in the exploitation of the medium to achieve the desired effects. We concluded earlier that the differences in the air and space media are

²⁶ Brigadier General Simon Peter Worden, USAF, “The Air Force and Future Space Directions: Are We Good Stewards?,” *Aerospace Power Journal* 15, no. 1 (Spring 2001): 51.

²⁷ Lt Col Peter Hays, USAF, and Dr. Karl Mueller, “Going Boldly—Where? Aerospace Integration, the Space Commission, and Air Force’s Vision for Space,” *Aerospace Power Journal* 15, no. 1 (Spring 2001): 45.

relevant to airpower theory and doctrine and that airpower theory is insufficient to guide the full exploitation of the space medium. The task now is to answer the question, “What operational impacts may occur as a result of how the service resolved the theory question?” As the “aerospace” decision is fairly recent, evidence of impacts should be relatively difficult to produce. However, given the above analysis indicating airpower theory and doctrine are unable to incorporate the physical differences in the space medium, perhaps the first place we would expect to see problems is in USAF doctrine. In fact, the evidence is apparent.

Before proceeding, however, it is worthwhile to return to Drew’s “doctrinal tree” analogy.²⁸ He defines environmental doctrine as, “...a compilation of beliefs about the employment of military forces within a particular operating medium.”²⁹ The logical inference from this definition is that distinct environmental doctrine, and hence theory, is required for each medium. In other words, having established space as a distinct medium, logic calls for the creation of distinct space theory and environmental doctrine. Leaving logic aside for the moment, Drew goes on to describe the purpose of doctrine. “If doctrine’s first function is to provide a tempered analysis of experience and thus a determination of what we believe, the second function must be to teach these beliefs or lessons to successors. Without the teaching function, analysis has little value.”³⁰

We find ourselves in a difficult position in attempting to identify effects from the decision to use airpower theory to exploit the space medium. Historical airpower theorists made no effort to include the exploitation of space in their theories and the USAF has not generated modified theory to incorporate differences. For this reason and

²⁸ Drew, 40-48.

²⁹ Drew, 44.

because current USAF doctrine claims to represent organizational thinking on the subject of exploitation, doctrine is the best tool available to achieve our purposes. An exhaustive review is neither possible nor warranted here; keeping the differences in the media outlined above and the teaching function of doctrine in mind, a single example will suffice.

Air superiority is the unchallenged cornerstone of airpower theory – but what of aerospace superiority? AFDD 2 says, “Air superiority is a prerequisite for all other combat operations.”³¹ The document goes on to say, “securing control of, and access to, the space environment is an increasingly vital function.”³² Already it is clear USAF doctrine is not treating “aerospace” as an “indivisible medium.” AFDD 2 segments “aerospace” into air and space by the degree of control necessary to perform operations in the two media. The reason why this segmentation occurs is also clear. Again, from AFDD 2, “Attaining air superiority provides both the freedom *to* attack and freedom *from* attack, as well as ensuring freedom to maneuver.” (emphasis in original)³³ In other words, air superiority is required to exploit the air medium to achieve the characteristic freedom of maneuver the medium offers not to mention enabling the other surface forces. We can also conclude that air superiority is binary in that if we have it, the adversary has lost it.

The inference that superiority in the space medium is different is entirely accurate, again due to the characteristics of the environment. Assuming a space system has achieved its desired orbital position and the requisite support network is functional, it has

³⁰ Drew, 43.

³¹ AFDD 2, 19.

³² AFDD 2, 19.

³³ AFDD 2, 19.

effectively achieved the freedom to operate; the requirement at this point is to defend and exploit the freedom. This accomplishment denies that specific orbital position to the adversary and that position only. The adversary remains free to operate space systems in any other orbital position he desires. In fact, with the exception of geosynchronous orbits, an adversary could quite conceivably operate a satellite in the exact same orbit, tracing the exact same ground path. In other words, space superiority is not the equivalent of air superiority. It is not achieved in the same manner, nor does achieving it yield similar operational effects. It goes without saying USAF doctrine does not explain these differences. Lacking fundamental space theory to guide the exploitation of the physical characteristics of the space medium, the portion of “aerospace” doctrine dealing with the space medium must rely on airpower theory – a body of theory that has nothing to say on these differences. The resulting intellectual vacuum surrounding the space portion of “aerospace” doctrine is every bit as empty as is the space medium itself.

It is clear from this analysis that attempting to “teach successors” about the exploitation of space, when viewed through the lens of airpower theory and doctrine, fails miserably. The impact on US warfighting capability resulting from the above disconnect is necessarily speculative, but the presumption that it will be negative seems irrefutable. Additionally, the organizational conflict between military services and internal to the USAF are areas of growing intensity and concern. The “come as you are” wars we envision in the future place a high premium on maximizing combat capability throughout all phases of conflict in support of NCA objectives. The USAF “aerospace” approach to exploiting the space medium does not meet this standard of performance.

Chapter 6

Conclusions

There is no more critical dimension of defense policy than to guarantee U.S. commercial and military access to outer space.

—U.S. Commission on National Security
Phase III Report, February 2001

The fundamental assumption on which this thesis relies is that the physical characteristics of a medium determine the operations possible within the medium. The fundamental question the study seeks to answer is whether the characteristics of the air and space media are sufficiently different to warrant development of independent space theory. To aid in answering the question, this study examined two cases in which decision-makers faced essentially the same issue: exploitation of the subsurface medium.

A caution at this point is necessary. Analogies can be dangerous and lead our thinking down inappropriate paths if not applied with extreme care. This study scrupulously avoided contending that the air and space case is “the same” as the naval cases. Likewise, the study does not contend the war’s outcome would have ultimately changed had either Japan or the US better understood the exploitation potential of the subsurface environment. Rather, the study contends that studying how the emerging potential of a medium was seized and exploited is useful for confronting exploitation decisions concerning air and space. The overriding lesson deduced from the case analysis is that each medium is different and offers exploitation opportunities not present in other media.

Physical Characteristics of the Media

The featureless terrain, vastness and accessibility of the sea surface stand in stark contrast to the concealment offered by the subsurface medium. Mahanian naval theory called for a decisive surface battle to establish control of the sea. Once established, control of the sea ensured the ability to affect the water-borne commerce of an adversary. Effectively exploiting subsurface concealment obviated the need for a fleet battle by directly attacking the adversary's maritime commerce. The analysis reveals that existing naval theory was incapable of incorporating the differences in the two media. The air and space media are likewise physically different and entirely distinct entities. Airpower theory exploits the freedom of maneuver gained through the speed, range, and flexibility of the air vehicle. Speed, range and flexibility in the context of airpower theory are concepts with little—if any—applicability to the space medium. Occupying a fixed position is anathema to airpower theory. Theory to exploit the space medium must emphasize the position-dominant nature of the environment, capitalizing on the predictability of space operations provided by the inflexibility of the physical laws governing orbital dynamics. As in the naval case, the characteristics of the space medium are sufficiently different to demand an independent theory to guide full exploitation of the medium.

“Aerospace Integration”

The case studies in this thesis clearly support the idea that *how* we choose to think about a given subject directly affects *what* options our thoughts produce. Naval planners in both Japan and the US clearly attempted to integrate the ability to exploit the subsurface medium into their established theory and doctrine for surface warfare. It is

equally clear that in making this integration attempt planners missed the effects potentially achievable through exploitation of a submarine's ability to operate independently. When war broke out, the US was unable to follow its preferred doctrine, yet lacked an alternative theory for accomplishing the newly assigned unrestricted warfare mission. Consequently, it took years to develop a workable doctrine, even given the attention and resources that wartime prioritization allowed. In Japan's case, they failed to realize the potential of the subsurface medium and this fact contributed immensely to their defeat.

The naval cases illustrate that integrating the new possibilities of an emerging medium into existing capabilities is necessary, but integration alone is insufficient to seize the full exploitation potential of the medium. Our emerging ability to exploit the space medium promises capabilities that will enhance the ability of military forces to create effects on the land, sea, and in the air. The specific theory for each of these media is the right tool to guide how these specific forces will exploit available space capabilities. However, this fact does not preclude achieving completely different effects by exploiting the space medium independent of terrestrial forces. Nor does it preclude enabling the other instruments of national power in ways not directly related to the use of military force. In short, exploiting the space medium offers the opportunity to achieve effects not possible via any other media. The clearest advice the naval cases offer is that new and potentially decisive effects are possible through the emerging ability to exploit a medium. Determining what these effects may be requires that we first develop the theory to understand what potential capabilities are possible as a result of the physical characteristics of the medium.

Spontaneous Space Theory

The idea that space theory will spontaneously arise if and when needed within a bureaucracy advocating an “indivisible aerospace medium” seems tenuous at best and dead wrong at worst. In both the US and Japanese navies, officers proposed workable strategies for submarine warfare only to have their ideas rejected by superiors who failed to recognize the potential for employing submarines to achieve strategic objectives. This outcome should not surprise us as scholars agree that bureaucracies – especially military bureaucracies – resist change.³⁴ The evidence of the naval cases suggests that the USAF’s “aerospace” integration approach will suppress the development of space theory, whether aerospace advocates intend that effect or not.

The inability of naval planners to anticipate effects on friendly operations resulting from enemy exploitation of the medium is the clearest warning of the naval case studies. Both US and Japanese maritime supply lines were vulnerable to hostile submarine operations, yet neither country recognized or acted to reduce this vulnerability. It is impossible to say for certain what might have happened had events transpired differently, but one could argue that different operational and potentially strategic effects were available to both nations, effects not realized due to theory-induced limitations in vision. Transferred to the air and space case, the evidence suggests the aerospace integration approach may cause us to miss effects achievable through more effective exploitation of the space medium.

The Commission to Assess United States National Security Space Management and Organization specifically raised the possibility of a “Space Pearl Harbor” disabling

³⁴ Williamson Murray, *Military Innovation in the Interwar Period*, ed. Williamson Murray and Allan R. Millett, (Cambridge: Cambridge University Press, 1996), 301.

attack, invoking the analogy as an “event able to galvanize the nation” into action.³⁵ While useful to illustrate the debilitating effects of an overwhelming surprise attack, the analogy also assumes an ability to identify, recover from, and eventually triumph over the attack. Assumptions are always dangerous but this one is especially so, as recovering from and defeating a surprise attack in space assumes a level of space medium exploitation capability that simply does not exist at present. Perhaps a more apt analogy is to think of space in terms of a “*Guerre de Course*” vulnerability as exemplified by Japan in WW II. Japan recognized their reliance on imports was essentially total, but never translated this understanding into recognition of a strategic vulnerability. Fixated on a strategy emphasizing decisive fleet battles, the Japanese were unable to envision an adversary exploiting their supply-line vulnerability without first destroying their fleet and made no advance defensive preparations. Consequently, they failed to react to the US attack until it was simply too late. In fact, the Japanese misunderstood the implications of submarine warfare to the extent that their operations actually worked to exacerbate their vulnerability. This too offers lessons to those responsible for developing military space capabilities. Finally, we must recognize that civilian owned and operated systems are part of the larger national vulnerability. The Pearl Harbor attack was against military forces at a military installation. The *guerre de course* analogy helps establish in our minds that an attack against space systems is almost certainly going to involve civilian systems with all the complications for policy this eventuality suggests.

³⁵ *Report of the Commission to Assess United States National Security Space Management and Organization*, submitted pursuant to sec. 1622 of Public Law 106-65, 11 January 2001, xxxi-xxxv. Available online at <http://www.space.gov>. Hereafter cited as “Space Commission Report.”

International Law

The prohibition against unrestricted submarine warfare had a firm basis in international law and enjoyed intense public support during peacetime, yet it fell to the wayside when victory became the objective. In an anarchic international system, it is dangerous to assume others will always adhere to international constraints that are, ultimately, unenforceable. Interpretations of what constitutes legal vice illegal actions necessarily vary between belligerents, to say nothing of the expediencies nations will adopt when their survival is threatened. Hays and Mueller make a convincing argument debunking the notion of a causal relationship between man's presence in a medium and the inevitability of combat in the medium,³⁶ however a causal relationship between a vulnerability and the attempt to exploit that vulnerability is much less debatable. Attempting to exploit an adversary's tactical, operational, or strategic vulnerability is the essence of warfare, to say nothing of state interactions short of war. The larger the vulnerability, the greater the temptation and incentive an adversary has to exploit it, international law notwithstanding. The Japanese case study illustrates this concept starkly. The similarity between maritime commerce and space-borne data transportation is a warning signal we must not overlook as we plan for future conflict.

Many people appear to believe that combat in, to and from space violates international law and use this supposed fact to argue against the increased exploitation of the medium. In actuality, combat in, to, and from space is completely legal under international law in all but the most specific circumstances, which are the use or

³⁶ Lt Col Peter Hays and Dr. Karl Mueller, "Going Boldly—Where? Aerospace Integration, the Space Commission, and the Air Force's Vision for Space," *Aerospace Power Journal* 15, no. 1 (Spring 2001): 39-40.

stationing of WMD in space and using space-based systems for NMD.³⁷ But just because space combat is legal in most cases does not mean that space combat is the most effective means to exploit the medium. Plainly and simply, we have an insufficiently detailed understanding of the space medium to accept the inevitability of space combat at face value. States have already begun contesting the ability to exploit space. The incidence of conflict in this arena is likely to accelerate rapidly; therefore, we need robust space theory to guide our military operations in space if those operations are to serve national objectives.

The Road Ahead

The presumption among space advocates that space exploitation is in its ascendancy is every bit as suspect as the USAF's assertion that treating "aerospace" as an indivisible medium is appropriate. Both positions assume an understanding of the underlying capabilities inherent in the space medium that simply does not exist. The epigraph opening this chapter is unequivocal in its prioritization of space within larger defense policy: there is nothing more important. The best defense policy return will be realized through an intellectual investment dedicated to understanding and exploiting the physical characteristics of the space medium. We would be ill advised to commit our national treasure before developing a theory to guide exploitation of the space medium. Consensus on the importance of operating in space is growing rapidly throughout the US government and lends the development of space theory a heightened sense of urgency.³⁸

³⁷ Treaty on Principles Governing the Activities of States in the Exploration and Use of Outer Space, Including the Moon and Other Celestial Bodies, The United Nations, (1967). Online at: <http://www.space.gov>.

³⁸ The author refers here to the reports of commissions studying the National Reconnaissance Office (NRO), the National Imagery and Mapping Agency (NIMA), the Space Commission Report, and the three

Having recognized our reliance on space, the question becomes whether we will commit the same mistake as the Japanese prior to WW II, or whether we will learn the lessons of history and seize the exploitation opportunities emerging from the space medium.

reports of the US Commission on National Security/21st Century. See *The NRO at the Crossroads* (Washington, D.C.: National Commission for the review of the National Reconnaissance Office, 1 November 2000); *The Information Edge: Imagery Intelligence and Geopolitical Information in an Evolving National Security Environment* (Washington, D.C.: December 2000); *Report of the Commission to Assess United States National Security Space Management and Organization*, submitted pursuant to sec. 1622 of Public Law 106-65, 11 January 2001. All three reports are available online at <http://www.space.gov>. From the US Commission on National Security/21st Century, see also *New World Coming: American Security in the 21st Century* (Washington, D.C.: 15 September 1999); *Seeking A National Strategy: A Concert for Preserving Security and Promoting Freedom* (Washington, D.C.: 15 April 2000); *Roadmap for National Security: Imperative for Change* (Washington, D.C.: 15 February 2001). Each of these reports is available online at <http://www.nssg.gov/Reports/reports.htm>.

Glossary

AFDD	Air Force Doctrine Document
AI	Aerospace Integration
BMD	Ballistic Missile Defense
DSCS	Defense Satellite Communication System
DSP	Defense Support Program
GPS	NAVSTAR Global Positioning System
LOC	Line of Communication
MLRS	Multiple Launch Rocket System
NGS	Naval General Staff (Imperial Japanese Navy)
SAAS	School of Advanced Airpower Studies
USAF	United States Air Force

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